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Introduction

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-16499*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center

A STUDY OF PRESSURE PREDICTION METHODS FOR RADIAL FLOW IMPELLERS Final Report, Jun. 1963–Mar. 1964

W. C. Keathley and H. F. Due 13 Apr. 1964 54 p refs

(Contract NAS8-5442)

(NASA-CR-58336; PWA-FR-952) OTS: HC $3.00/MF $0.50

Experimental tests were conducted and analysis was made to derive an accurate method for predicting the pressure distribution along radial-bladed and smooth rotating disks operating with little or no meridional flow. Using water as the test fluid, tests were conducted on a test apparatus with an 11-inch-diameter rotor over a range of rotor-to-casing axial clearances from 0.125 to 0.040 inch. Flow coefficients from zero to 0.02 and speeds from 2000 to 8000 rpm were investigated. Five rotor configurations were studied: (1) 24 blades, 0.125 inch high, (2) 24 blades, 0.250 inch high, (3) 12 blades, 0.125 inch high, (4) 6 blades, 0.125 inch high, and (5) a smooth disk. Pressure data at several radial stations, torque data, and high frequency blade-to-blade pressure data were taken at various flows and speeds for the specified configurations. Methods were derived from the data to enable a more accurate prediction of pressure distribution than has previously been available. A comparison of the applicable prediction methods with experimental data from an existing high pressure liquid oxygen pump is presented. Author

N65-16520# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

A METHOD FOR DESIGNING PERFECT SUPERSONIC COAXIAL NOZZLES Mathematical Note No. 299

F. Edward Ehlers Jun. 1963 21 p refs

(D1-82-0258)

Procedures are described for the design of a coaxial nozzle for laboratory study of jet engine flow exhaust pattern. The nozzle is axially symmetric, the outer wall is a circular cylinder, and the inner wall is contoured to obtain uniform flow in a test section. Programs are coded for the problem on the IBM 1620 and 7090 computers. The coordinates of a nozzle contour for an exit Mach number of 2.5 are given. R.L.K.

N65-16576*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DETERMINATION OF LOADS ON A FLEXIBLE LAUNCH VEHICLE DURING ASCENT THROUGH WINDS

Harold C. Lester and Dennis F. Collins Washington, NASA, Feb. 1965 67 p refs

(NASA-TN-D-2590) OTS: HC $3.00/MF $0.75

An analytical procedure is developed for computing the pitch plane motions and bending moments experienced by a flexible launch vehicle during ascent through atmospheric winds. Structural bending is approximated by the superposition of several beam modes, and propellant slosh is treated by a mechanical analogy. Nonlinear, time-dependent equations of motion are derived by using a variational procedure which is applicable to variable mass systems. As an illustrative example, the method is applied to a typical launch vehicle, and the responses are computed numerically by means of an equivalent fifth-order integration. The method is particularly suitable for use with detailed wind velocity profiles such as those obtained by the smoke-trail technique. Author

N65-16578*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF FIN-FLARE COMBINATIONS ON THE AERODYNAMIC CHARACTERISTICS OF A BODY AT MACH NUMBERS 1.61 AND 2.20

Clyde Hayes and Roger H. Fournier Washington, NASA, Feb. 1965 40 p refs

(NASA-TN-D-2623) OTS: HC $2.00/MF $0.50

An investigation was conducted in the Langley 4- by 4-foot supersonic pressure tunnel at Mach 1.61 and 2.20 to determine the effectiveness of various combinations of fins and flares in stabilizing a cone-cylinder missile configuration having a fineness ratio of 10. An increase in either fin or flare angle led to significant increases in the normal-force-curve slope and the stability level and to a small increase in axial force due to the fins, but to a rather large increase in axial force due to the flares. The addition of flares to the model with 1/6 body length fins had little effect on the normal-force-curve slope and the stability level until the flare angle became sufficiently steep to cause flow separation forward of the flare-body juncture. The resulting flow separation caused an increase in the normal-force-curve slope and in stability level. The addition of flares to the model with 5/12 body length fins generally resulted in a slight decrease in the normal-force-curve slope and stability level. Author

N65-16885*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF THE DYNAMIC STABILITY AND CONTROLLABILITY OF A TOWED MODEL OF A MODIFIED HALF-CONE REENTRY VEHICLE

Robert E. Shanks Washington, NASA, Feb. 1965 25 p Film Supplement to this report is available on loan from Langley Res. Center
(NASA-TN-D-2517) OTS: HC $1.00/MF $0.50

An investigation of the low-speed dynamic stability and controllability of a 1/3-scale model of a modified half-cone reentry vehicle in towed flight was made in the Langley full-scale tunnel by means of flying-model tests. The model was tested with and without artificial damping in roll and in yaw. Tests were made through a towline-angle range from −5° (high tow) to 6° (low tow). The investigation showed that, in general, the model had satisfactory longitudinal stability and control characteristics but unsatisfactory lateral stability characteristics due to a combination of a lightly damped Dutch roll oscillation and an unstable long-period oscillation in which roll and sidewise motions were large in comparison with yaw displacements. The adverse motions could be controlled fairly easily with either coordinated aileron and rudder control or rudder-alone control, but not with aileron-alone control. This combination of stability and controllability was considered unsatisfactory for general operation but acceptable for relatively short periods of operation under visual conditions. The addition of artificial damping in roll made the flights smoother and the control easier, but the model was still unstable; the addition of artificial damping in yaw made the model stable, but the rolling motions were damped only moderately well; and the addition of both damping in roll and damping in yaw resulted in a very stable towed model. Author

N65-16887*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INLET NOISE STUDIES FOR AN AXIAL-FLOW SINGLE-STAGE COMPRESSOR
W. Latham Copeland Washington, NASA, Feb. 1965 21 p refs
(NASA-TN-D-2615) OTS: HC $1.00/MF $0.50

The present studies involved the use of a single-stage research compressor without stators that was adapted to an outdoor test setup to obtain some basic inlet noise data. The objectives were to investigate the effects of inlet duct geometry (such as length of duct and duct resonators) on the radiated noise of this compressor for a range of tip speeds, pressure ratios, and blade loading conditions. The data are presented in the forms of radiation patterns, frequency spectra, and pressure time histories. A significant reduction in noise level was obtained by increasing inlet duct length and also by using an inlet resonator. The radiation patterns for the overall noise were nearly circular. However, the noise pressures analyzed at the blade-passage frequency exhibited lobed patterns. The spectra of the noise contained two broad noise peaks and some discrete frequency harmonics of the blade-passage frequency. Amplitude modulations similar to those for other single- and multiple-stage axial-flow compressors are evident in the time histories of the discrete blade-passage frequency. Author

N65-16892*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRIM REQUIREMENTS AND STATIC-STABILITY DERIVATIVES FROM A WIND-TUNNEL INVESTIGATION OF A LIFTING ROTOR IN TRANSITION
Julian L. Jenkins, Jr. Washington, NASA, Feb. 1965 38 p refs
(NASA-TN-D-2655) OTS: HC $2.00/MF $0.50

A wind-tunnel investigation of a 15-foot-diameter rotor was made to determine the trim requirements and static-stability derivatives for rotor operation at transition speeds. In addition, photographs of a vertical tuft grid in the longitudinal plane below the rotor were taken to indicate the influence of the rotor downwash on an aircraft fuselage. The linear increase in longitudinal control requirement with increasing speed exhibited by the rotor suggests that the longitudinal control-position instability encountered at low speeds may be primarily a function of rotor-fuselage interference effects. The comparisons of experimental with theoretical static-stability derivatives indicate that the derivatives of rotor thrust, torque, and longitudinal flapping are predictable at tip-speed ratios as low as 0.04. Author

N65-17078# Aerophysics Co., Washington, D. C.
A STUDY OF RADIAL-FLOW FANS FOR GEM PROPULSION SYSTEM APPLICATIONS Final Report
Gabrie D. Boehler et al Ft. Eustis, Va., Army Transportation Res. Command, Jul. 1964 202 p refs
(Contract DA-44-177-AMC-886(T))
(TRECOM-TR-64-33; AD-610522)

Existing lift systems for air cushion vehicles (ACVs) display two fundamental weaknesses: excessive internal losses resulting in low system efficiencies, and poor adaptability to fluctuations in cushion pressure. Demonstrated performance of the rotating diffuser (RD) as a basic air mover eliminated the latter objection, although existing applications were designed without the weight considerations for airborne or air-supported operations. The study analyzes the fan loadings and the configuration constraints for ACVs as they apply to the rotating diffuser and, through scale model tests, determines the internal efficiency of such a system. The results indicate the consistently high internal efficiencies exceeding the best present ACV lift-system performance by 40 to 45 percent over a broad range of loadings can be provided by an RD fan system weighing no more than existing fan-duct-nozzle systems. Author

N65-17079# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
TABLES OF TWO-DIMENSIONAL OSCILLATING AIRFOIL COEFFICIENTS FOR ROTARY WINGS
Raymond A. Piziali Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1964 318 p refs
(Contract DA-44-177-AMC-119(T))
(CAL-BB-1898-S-1; TRECOM-TR-64-53; AD-610029)

Tables of numerical values of Loewy's modified two-dimensional lift-deficiency function for rotor blades are presented. The lift-deficiency function is tabulated for a greater range of parameter values and for smaller increments than were previously available. The parameters referred to are the reduced frequency, the ratio of blade oscillatory to rotor rotational frequency, and the rotor inflow ratio. Author

N65-17116*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF A LIFTING ROTOR OPERATING AT TIP-SPEED RATIOS FROM 0.65 TO 1.45
Julian L. Jenkins, Jr. Washington, NASA, Feb. 1965 23 p refs
(NASA-TN-D-2628) OTS: HC $1.00/MF $0.50

A wind-tunnel investigation of a 15-foot-diameter rotor was made to explore rotor operation at tip-speed ratios near 1.00. A two-blade teetering-type rotor system was tested in the full-scale tunnel for tip-speed ratios from 0.65 to 1.45. Although the results indicated that rotor efficiencies as high as 13 can be attained at the highest tip-speed ratio investigated, the slope of the variation of rotor thrust with collective pitch was negative for a constant disk attitude at tip-speed ratios greater than 1.00. The negative slope resulted primarily from the increased sensitivity of the rotor longitudinal flapping response with respect to collective pitch as compared with the sensitivity of the flapping response with respect to angle of attack. The theoretical calculations of the rotor characteristics also indicated this reversal phenomenon. Author

N65-17154# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (West Germany). Institut für Angewandte Gasdynamik

INFLUENCE OF FINITE SPAN AT THE TRAILING EDGE OF LOW ASPECT RATIO WINGS OR FINITE CROSS-SECTIONAL AREA AT THE APEX OF POINTED SLENDER BODIES OF REVOLUTION ON THE FLOW ON THE BODY AND BEHIND IT [EINFLUSS ENDLICHER SPANNWEITE ODER ENDLICHER FLACHE IM ENDQUERSCHNITT VORN SPITZER FLUGEL KLEINER STRECKUNG ODER SCHLANKER ROTATIONSKORPER AUF DIE STROMUNG AM UND HINTER DEM KORPER]

Friedrich Keune Sep. 1964 61 p refs In GERMAN; ENGLISH and FRENCH summaries

(DLR-FB-64-21; DVL-365) Available from ZLDI, Munich: 14.50 DM

The theory demonstrates that higher approximations are proportional to even powered cross-sectional distances which is an important fact for the working of the iteration method to fulfill the boundary condition on given body shapes. For example, the flow on a half body of revolution with an added cylinder is compared with the results of slender body theory in subsonic flow as well as in supersonic flow. Moreover, the subsonic velocity potential for a wing with rectangular planform is compared with the flow on an equivalent body of revolution. Author

N65-17167# Wisconsin Univ., Madison. Mathematics Research Center

NONUNIFORM STEADY FLOW OF AN IDEAL FLUID PAST AIRFOILS. PART I: SOME EXACT SOLUTIONS FOR TWO-DIMENSIONAL NONUNIFORM FLOW OF EXPONENTIAL TYPE

J. Weissinger Oct. 1964 76 p refs

(Contract DA-11-022-ORD-2059)

(MRC-515; AD-610445)

The main difficulty in nonuniform flow is that the Euler equations cannot be linearized exactly. For two-dimensional flow there are only two exceptions: linear shear flow that can be reduced to the Laplace equation and therefore, does not lead to principally new problems, and a flow, called exponential, in which the main stream velocity has the form $ae^{cy} + be^{-cy}$ For this flow exact solutions by expansions into modified Bessel functions or Mathieu functions are given if the profile is a circle, an ellipse, or a flat plane airfoil. For the latter the analog of the so-called singularity method based on the concept of a vortex sheet is also developed. The solution is determined by a singular integral equation, for which a numerical method is outlined. The numerical results are compared with those of uniform and of linear shear flow. Author

N65-17231# Sandia Corp., Albuquerque, N. Mex.

A COMPILATION OF LONGITUDINAL AERODYNAMIC CHARACTERISTICS INCLUDING PRESSURE INFORMATION FOR SHARP- AND BLUNT-NOSE CONES HAVING FLAT AND MODIFIED BASES

A. D. Foster, comp. Jan. 1965 593 p refs For suppl. see SC-R-64-1312

(SC-R-64-1311; SC-R-64-1312) OTS: $8.96

Only a limited amount of aerodynamic information is available on generalized cone geometries over a wide range of Mach numbers and angles of attack. This report presents an accumulation of a large amount of these unclassified cone stability and pressure data by order of the cone half angle. Both experimental and theoretical data are included. A bibliography is also included which consists of several references to sources containing theoretical and/or experimental data on the aerodynamic characteristics of cones. Author

N65-17327*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC AERODYNAMIC CHARACTERISTIC OF A SERIES OF BODIES HAVING VARIATIONS IN FINENESS RATIO AND CROSS-SECTIONAL ELLIPTICITY

Bernard Spencer, Jr. and W. Pelham Phillips Washington, NASA, Feb. 1965 86 p refs

(NASA-TN-D-2622) OTS: HC $3.00/MF $0.75

An investigation was made in the Langley high-speed 7- by 10-foot tunnel to determine the longitudinal and lateral aerodynamic characteristics at transonic speeds of a series of low-wave-drag lifting bodies having variations in fineness ratio and cross-sectional ellipticity. Increasing horizontal-to-vertical axis ratio for a body having a given fineness ratio results in increases in the variation of lift and lift-drag ratio with angle-of-attack at all test Mach numbers. Increasing fineness ratio for a body with any given horizontal-to-vertical axis ratio results in slight reductions in the drag at zero lift at all test Mach numbers and large reductions in the transonic drag rise noted for the bodies. At all test Mach numbers, the highest values of lift-drag ratio obtained for any horizontal-to-vertical axis ratio occur for the body having the highest fineness ratio. There are only minor effects of changing fineness ratio on the longitudinal center-of-pressure location for low angles-of-attack in the Mach number range of the investigation. Author

N65-17400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SMALL DEVIATIONS OF CONSUMPTION IN CALCULATED CONDITIONS ON THE MAIN CHARACTERISTICS AND PARAMETERS OF STAGE OUTPUT ON FLOW OF AXIAL COMPRESSOR

V. N. Novotel'nov 17 Mar. 1964 14 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zaved., Energ. (Minsk), no. 12, 1962 p 63–69

(FTD-MT-64-95; AD-605900) OTS: $1.00

A method for obtaining the relation between the coefficient of consumption and the deviations of other parameters of axial compressors is presented. The proposed method shows the possibility of estimating the deviation of pressure, kinematic reaction, and speed depending upon deviations of the coefficient of consumption. Also, distribution of parameters, determined by the method, gives satisfactory convergences with experimental data. E.E.B.

N65-17456*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED FORCE AND FLIGHT INVESTIGATION OF A MODEL OF A MODIFIED PARAWING UTILITY VEHICLE

Joseph L. Johnson, Jr. Washington, NASA, Mar. 1965 60 p refs Film Supplement to this report is Available on Loan from Langley Res. Center

(NASA-TN-D-2492) OTS: HC $3.00/MF $0.50

A low-speed wind-tunnel investigation was made to determine the flight characteristics of a model of a parawing utility vehicle. The model was generally similar in design to an earlier model of a parawing utility vehicle flight tested, but incorporated several design changes, primarily in the area of control. Included in the modifications was a 35° vee-tail installed to provide pitch and yaw control. In addition, the aft 14% of each leading edge of the parawing was hinged to deflect with wing bank much like a servo tab in an effort to reduce the large lateral hinge moments associated with the wing-bank control system. The results showed that the model had generally satisfactory stability characteristics over the angle-of-attack range covered in the flight tests, but force tests

showed that it had a pitch-up tendency at angles-of-attack above those covered in the flight tests. The control effectiveness provided by the design control system was unsatisfactory about each of the three axes in some flight conditions. A revised control system was devised, however, which gave satisfactory control. Author

N65-17485# Little (Arthur D.) Inc., Cambridge, Mass.
ROTATION OF BALLOONS AT FLOATING ALTITUDE Technical Report III
A. E. Germeles, R. M. Lucas, and E. R. Benton (Nat. Center for Atmospheric Res.) Dec. 1963 44 p refs
(Contract Nonr-3164(00))
(C-62944; AD-426834)

The use of high altitude balloons as stable platforms for meteorological and astronomical observatories necessitates an investigation of the dynamic behavior of balloons. This report deals with the azimuthal rotations of the balloon-gondola system. The aerodynamic damping and inertia of the system were mathematically formulated and experimentally verified. The forcing torque, mostly aerodynamic in nature, was described and its order of magnitude was estimated for known balloon rotations. These rotations were alleviated in the past by control systems which orient the gondola by reaction torques applied to the balloon. The aerodynamic parameters that are evaluated can be useful in the design of such a control system. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-16425# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
EXPERIMENTAL DETERMINATION OF THE THREE MOMENTS OF INERTIA AND THE PRODUCT OF INERTIA IN THE PLANE OF SYMMETRY OF THE NLR LABORATORY AIRCRAFT SIEBEL 204-D-1
C. H. v. d. Linden and A. Blaauw Sep. 1963 34 p refs
(NLR-TN-V. 1912)

Moments of inertia I_x, I_y, and I_z, respectively, about the three aircraft body axes, and the product of inertia in the plane of symmetry I_{xz} have been determined as part of an investigation on the application of nonstationary flight test techniques for the evaluation of aircraft stability and control characteristics. The actually applied experimental technique consisted of swinging the aircraft about appropriate axes and measuring the periods of the oscillations. The results, as compared to factory design data, show good agreement for the roll axis, less but still reasonable agreement for the yaw axis (difference < 10%), but a large difference for the pitch axis. The obtained experimental value is some 40% higher and in good agreement with the expected value as based on an analysis of longitudinal flight-test response data. Author

N65-16554# General Dynamics/Convair, San Diego, Calif.
ENGINEERING SUMMARY OF AIRFRAME ICING TECHNICAL DATA
D. T. Bowden, A. E. Gensemer, and C. A. Skeen Washington, FAA, Mar. 1964 485 p refs
(Contract FA-WA-4250)
(FAA-ADS-4; AD-608865)

Data are presented on aircraft icing conditions, methods of preventing and removing ice on aircraft in flight, and methods of testing ice protection systems to ensure adequacy. The report is divided into six sections: The first discusses statistical icing data to be used as design criteria for ice protection evaluations and systems. The second section is concerned with the physics of ice collection, and presents formulas and charts for determination of the rate, size, and shape of ice formations on aircraft. The third section discusses the known methods of ice protection, and presents formulas and data to be used in design. The fourth section shows specific and typical applications of ice protection systems to light and heavy aircraft. The fifth section presents data on detection of icing by visual means and by ice detector and indicator systems. The final section discusses the various methods of testing aircraft for adequacy of icing protection with and without ice protection systems. Included are data on icing tunnel testing, dry air flight testing, flight testing in natural icing, and flight in simulated icing. Author

N65-16709# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe
LAY-OUT AND APPLICATION OF EJECTORS FOR V/STOL-AIRPLANES, PART 2 [DIE ANWENDUNG DES EJEKTORS BEI V/STOL-FLUGZEUGEN UND DESSEN AUSLEGUNG, 2. TEILBERICHT]
C. Storkebaum Aug. 1964 33 p In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-64-25) Available from ZLDI, Munich: 8 DM

In the extended incompressible, loss-free calculation for ejectors, the effect of the density ratio on velocity ratio and mass ratio, and on thrust increase is discussed. The relation of these values in dependence of the aspect ratio is explained by means of diagrams and nomograms. Author

N65-16952# Thurston Erlandsen Corp., Sanford, Maine.
FLIGHT TEST OF THE HYDRO-SKI RESEARCH VEHICLE (HRV-1) EQUIPPED WITH TEC SKIS NO. 2 AND NO. 3 ON STRUT NO. 2 Final Summary Report
O. Erlandsen and D. B. Thurston 21 Dec. 1964 56 p refs
(Contract N600(19)59309)
(Rept.-6402-3; AD-456077)

Tests of aircraft are reported, in which one strut design and two ski designs were evaluated. The performance of the strut and of the skis is described, and it is reported that the spray and bounce characteristics of the cambered ski, as well as its prevention of takeoff, make it of less use than the straight ski. Structural characteristics and a narrative of the tests are also given. D.E.W.

N65-17081# Hydronautics, Inc., Laurel, Md.
THE STATIC PERFORMANCE OF GROUND EFFECT MACHINES WITH ASPECT RATIOS OF 1/3, 2/3, 1-1/2, AND 3
Emanuel S. Curtis and Mark W. Chodoff Dec. 1964 56 p refs
(Contract Nonr-3189(00))
(TR-011-6; AD-610219)

The results of an experimental investigation of the static pitch performance of aspect ratios 1/3, 2/3, 1 1/2, and 3 ground effect machine models with interior nozzles are presented. The investigations consisted of the measurement of the lift, moment, plenum chamber pressure, and rate of airflow to the models at three heights and for various pitch angles. It

was shown that the four configurations are statically stable and have restoring moments at all of the heights for which tests were conducted. Observations of the flow beneath the model were made in an effort to gain an understanding of the role of the interior jets on the stability of the models. It is also shown that the thin jet theory satisfactorily predicts the lift and moment of a ground effect machine at high heights only. Author

N65-17084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONGITUDINAL STABILITY OF AN AIRPLANE WITH DELAYED ACTION AUTOPILOT
V. S. Kislyakov 3 Dec. 1964 13 p refs Transl. into ENGLISH from Avtomat. Regulir. i Upr., Akad. Nauk (USSR), 1962 p 115–123
(FTD-TT-64-335/1+2; AD-609781)

From the investigation of longitudinal stability of an aircraft with an autopilot which is making short-period movements, one can draw the following conclusions: (1) The presence of delay in the autopilot has a substantial effect on the stability of the airplane. This effect is expressed by considerable narrowing down of the transmittable numbers of the autopilot. (2) Not taking the delay into account may lead to the choice of autopilot design that is outside the area of the asymptotic stability of the system, i.e., to instability. (3) The permissible value for the delay in the autopilot depends on and is determined by the values of the aerodynamic coefficients $\overline{M}_z^{\omega_z}$ and $M_z^{\dot{z}}$. With a given value of delay, the aerodynamic coefficients determine the permissible adjusting of the autopilot. (4) The periodic oscillations (natural oscillations) which are set up in the boundary area of the asymptotic stability of the system are stable for small values, i.e., the boundary is safe for small magnitudes. Author

N65-17128*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE IMPACT OF V/STOL AIRCRAFT ON INSTRUMENT WEATHER OPERATIONS
John P. Reeder Washington, NASA, Feb. 1965 18 p refs
(NASA-TN-D-2702) OTS: HC $1.00/MF $0.50

Experiments in IFR approach and landing maneuvers with V/STOL aircraft are reported. Simultaneous operation of V/STOL and conventional aircraft in commercial traffic patterns is discussed. It is shown that the inherent low-speed short-distance maneuvering capabilities of present V/STOL aircraft offer potential advantages in reduction of weather minima for safe operation. It is concluded that improvements are required in handling qualities, pilot displays, and instrument approach techniques. E.P.V.

N65-17145# General Electric Co., Johnson City, N.Y. Light Military Electronics Dept.
ANALYTICAL INVESTIGATION OF CONTROL REQUIREMENTS FOR HIGH SPEED LOW ALTITUDE PENETRATION Final Report Brief, Jul. 1, 1963–May 10, 1964
R. P. Quinlivan, G. Tye, and H. H. Westerholt Dec. 1964 30 p refs
(Contract AF 33(657)-11318)
(FDL-TDR-64-104; AD-604684)

Evaluation of the simulated system performance was the chief means of system analysis. The evaluations were made using four terrain samples, and included seventeen combinations of aircraft configuration and flight conditions, gust disturbances, and radar errors. A limited evaluation of manual control was made. It is concluded that the conceptual approach and techniques studied promise to give advanced automatic-terrain following systems, with superior performance in real environments without adjustment for changes in flight dynamics or terrain characteristics. Author

N65-17253# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PILOTING PECULIARITIES OF JET AIRCRAFT
M. L. Gallay 22 Sep. 1964 197 p refs Transl. into ENGLISH of the book "Osobennosti Pilotirovaniya Reaktivnykh Samoletov" Moscow, Izd. DOSAAF, 1962 p 1–196
(FTD-MT-64-148; AD-608601)

This manual is intended to introduce jet aircraft operation to pilots, flight instructors, engineers, and technicians who are familiar with propeller-driven aircraft. Procedures during the various stages of flight are given, along with the reasons for the procedures. Examined in detail are those aerodynamic questions necessary for the understanding of jet flight. Material in the the manual is chiefly applicable to subsonic jet aircraft with turbojet engines, but reference is also made to supersonic jet aircraft, and to aircraft with turboprop engines. R.L.K.

N65-17325# Kellett Aircraft Corp., Willow Grove, Pa.
TESTS OF ENGINE INGESTION OF A FULL-SCALE REFLECTION PLANE MODEL OF THE DUCTED FAN TANDEM VTOL RESEARCH AIRCRAFT Interim Report
R. R. Pruyn and B. V. Wacholder 17 Jul. 1964 70 p refs
(Rept.-179T80-11; AD-456099)

A full scale half-model simulation of a dual tandem ducted propeller VTOL aircraft was tested under the severe environment caused by operation simulating vertical flight in close proximity to sand and crushed stone covered terrain. The model was the same as that used in similar previous downwash effects programs, except that airflow into the simulated aft wing mounted engines was provided. Four engine inlet protection devices were evaluated in this series of tests. Based on previous promising results, a wing-like deflector device was tested in two configurations of different chord lengths. A full inlet screen and a blocked half-screen inlet protection device were also tested. It was found that due to its location in the upflow region, the full screen tended to collect particles and thereby aggravated inlet ingestion. The blocked half-screen and the deflector devices significantly reduced ingestion, but were not sufficiently effective to positively prevent engine damage. Tests over crushed stone caused significantly worse engine ingestion and airframe damage problems than those experienced over sand. Author

N65-17335*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SYSTEM FOR VARYING THE STABILITY AND CONTROL OF A DEFLECTED-JET FIXED-WING VTOL AIRCRAFT
Frank A. Pauli, Daniel M. Hegarty, and Thomas M. Walsh Washington, NASA, Mar. 1965 29 p refs
(NASA-TN-D-2700) OTS: HC $2.00/MF $0.50

A system to provide variable control power and augmented stability for a hovering VTOL aircraft is described. On the Bell X-14A aircraft, the exhaust of the two jet engines is deflected to provide lift for hovering flight. Bleed air is taken from the engines and used for reaction control at the wing tips and tail for attitude control while hovering. Two sets of reaction nozzles are used on the modified X-14A. The original set is mechanically actuated by the pilot; the other set, which uses electric servo-driven nozzles, was added to generate variable-stability control moments about all axes. Variable-stability modes provided are rate damping, cross coupling cancellation, augmented pilot control, and stiffness with maneuverability cutout. The control system for one axis is outlined, and criteria

for dividing bleed air between the two sets of nozzles are presented. The development of the nozzles for constant flow and pilot safety controls is discussed. Author

N65-17458*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPIN-ENTRY CHARACTERISTICS OF A DELTA-WING AIRPLANE AS DETERMINED BY A DYNAMIC MODEL
James S. Bowman Washington, NASA, Mar. 1965 52 p refs
(NASA-TN-D-2656) OTS: HC $2.00/MF $0.50

An investigation was conducted by means of catapult tests on a 1/40-scale dynamic model to determine the spin-entry characteristics of a delta-wing airplane loaded primarily along the fuselage. Spin-entry motions were readily obtainable for the normal center-of-gravity range of the airplane, but the motion occurred much faster for forward center-of-gravity positions than for rearward center-of-gravity positions. The use of ailerons was effective in promoting or preventing the spin entry, and their effect was qualitatively the same as it was for the fully developed spin; that is, ailerons moved against the direction of yawing rotation (left when turning to right) promoted the spin entry, and the use of ailerons with the direction of yawing promoted recovery from the spin entry. The optimum control technique for terminating the spin-entry motion was immediate movement of the ailerons with the rotation, and of the rudder against the rotation, while maintaining the up-elevator deflection that had caused the stall. As rotation stops, the controls should be neutralized and the stick eased forward to initiate a dive to regain flying speed. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-16347*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW ENERGY PROTON DAMAGE EFFECTS IN SILICON AND GALLIUM ARSENIDE SOLAR CELLS
D. M. Brown [1965] 20 p refs
(NASA-TM-X-54990) OTS: HC $1.00/MF $0.50

Silicon n-p cells of various base resistivities and gallium arsenide p-n solar cells were irradiated with nominally 0.6, 1.8 and 4.7 MeV protons. In the first experiment silicon n-p cells of various base resistivities and gallium arsenide cells were irradiated with 4.7 MeV proton, measuring I_{sc} and V open as functions of flux. In the second experiment, the same types of cells were irradiated with 0.6 MeV protons, with I-V curves and spectral responses being measured. In the third experiment, a similar set of cells were irradiated with 1.8 MeV protons, with I-V curve and spectral response being measured. Author

N65-16446*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALIBRATION OF SOLAR CELLS USING HIGH-ALTITUDE AIRCRAFT
Henry W. Brandhorst, Jr. and Earle O. Boyer Washington, NASA, Feb. 1965 22 p refs Film Supplement to this Report is Available on Loan from Lewis Res. Center
(NASA-TN-D-2508) OTS: HC $1.00/MF $0.50

An airplane was used to carry solar cells to various heights ranging from 12 000 to 47 000 ft. Airmasses above the cells then ranged from 0.14 to 1.2, depending on the altitude and the time of year. Semilogarithmic plots of the short circuit current against airmass proved to be linear within experimental error as predicted by theory. Extrapolation of the plots to airmass zero yielded short circuit currents equivalent to outer-space short circuit currents, except for a correction for absorption of sunlight by ozone. This correction factor could be calculated with sufficient accuracy and was about 1 percent. In addition to the ozone correction, the results were normalized to a solar intensity of one solar constant (139.6 mw/sq cm), and when necessary, to a standard temperature. In order to determine the absolute accuracy of the method, standard solar cells calibrated for outerspace conditions by a variety of techniques were flown. For cells calibrated on a solar simulator, the agreement was within ±1 percent. For cells calibrated in terrestrial sunlight on Table Mountain, California, the correlation was again within ±1 percent. The final tests were made with secondary standards prepared by careful comparison and matching of cells with a balloon-flown primary standard solar cell. In this case, agreement was within 0.5 percent. Author

N65-16449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR EVALUATION OF A TWO-STAGE SODIUM VAPOR TURBINE
Harold J. Schum and Thomas P. Moffitt Washington, NASA, Feb. 1965 18 p refs
(NASA-TN-D-2661) OTS: HC $1.00/MF $0.50

A two-stage sodium vapor turbine was experimentally investigated using air as the driving fluid. The overall performance of the turbine was obtained over a range of equivalent speeds and pressure ratios. Similarly, the performance of the first stage of the turbine was determined when tested as a separate component, and stage-work distribution was evolved. At the equivalent design speed and pressure ratio (5.55), the turbine produced a work output of 33.40 Btu/lb, which was about 4% less than the equivalent design work of 34.96 Btu/lb. The attendant efficiency was 0.693 as contrasted to the predicted efficiency of 0.725. The turbine exhibited efficiencies of over 0.74 at off-design operation. The equivalent air-weight flow for the turbine was found to be limited by choking in the first-stage stator at 1.71-lb/sec, 2.7% less than the design value. The first stage of the turbine was tested as a separate component and correlated to the two-stage tests. Results indicated that, at the equivalent design speed and pressure ratio, the first stage produced about 57% of the total equivalent work output (33.40 Btu/lb). The turbine was designed for even work split for each stage. Author

N65-16570# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
A SIMPLE AND RELIABLE ARC PLASMA GENERATOR STARTER
T. A. Barr, Jr. and R. F. Mayo 7 Dec. 1964 17 p ref
(RR-TR-64-20; AD-455955)

A reliable and simple spark plug type starter system for igniting arc plasma generators is discussed. The system is capable of igniting one or more arcs (with or without small axial magnetic fields) with only normal open circuit voltages across the electrodes. The starter system was found to operate reliably in a rotating arc plasma generator for air pressures ranging from 1.5 to 600 torr and in open circuit voltages ranging from 50 to 1800 V dc in the plasma generator. Ignition of both arcs in a two-generator system occurred within 0.1 μsec when the spark plug starters were used. The power

supply for the starters is arranged so that voltage appears simultaneously on all the starter spark plugs at the time of ignition. Except for a small transient voltage during the recharge cycle and during discharge, the starters are at ground potential. The starter system was used successfully both in the test apparatuses described here and in a two-arc plasma facility. It will be used also in a six-arc, 8000-kW plasma facility that is under construction. Author

N65-16741*# Leesona Corp., Great Neck, N. Y. Leesona Moos Labs.
THE IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Second Quarterly Report, 13 Sep.–12 Dec. 1964
J. Oxley, G. Johnson, and W. Ryan [1964] 43 p
(Contract NAS5-3908)
(NASA-CR-60696) OTS: HC $2.00/MF $0.50

The E–i characteristics of the $Zn/Zn(OH)_4^=/KOH$ system have been characterized further using rapid, controlled-potential sweeps. The data are in agreement with the previous data and support the existence of a passive region. The thin oxide layers produced were capable of reduction at extremely high current densities. Metallographic cross sections of dendrite growths show no relationship betwen nucleation sites and grain orientation or grain boundaries. The large number of slip plane defects observed may be a contributing factor. One cross section clearly shows that only a small proportion of nucleated dendrites propagate to significant dimensions when charged under diffusion-limited conditions. The rate of propagation of dendrites was measured in terms of mm/coulomb. The importance of zincate diffusion as a controlling factor in propagation of dendrites, and some possible effects of anion complexation are also discussed. Author

N65-16742*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
TWO STAGE POTASSIUM TEST TURBINE Quarterly Progress Report No. 13, May 8–Aug. 8, 1964
E. Schnetzer ed. [1964] 142 p
(Contract NAS5-1143)
(NASA-CR-54211) OTS: HC $4.00/MF $1.00

A two-stage test turbine being developed for operation in saturated potassium vapor at 1600° F underwent its first potassium vapor test, and the performance data are presented and discussed. Evaluation of the converging–diverging potassium nozzle data continued. Average values of inlet to local polytropic exponent were compared at various values of inlet temperature and initial vapor quality. Efforts were continued to identify and eliminate the oil leakage problems. This was successfully accomplished by minor changes in component design and improvement of static seals. In operating the turbine on potassium vapor, turbine inlet temperatures in excess of 1450° F were reached, and the turbine was operated for approximately 4 hours. Materials support involved testing of new sealing ring configurations; testing the potassium resistance of the fluorinated hydrocarbon sealing material, Viton; stress-to-rupture tests performed on U-700 material which was exposed to both precipitation heat treatment and to the A-286 heat treatment; investigation of oil contamination of the potassium in the main potassium loop of the turbine facility; boiler exhaust potassium detection; and turbine materials rub testing. R.L.K.

N65-16744*# Globe-Union, Inc., Milwaukee, Wis.
A PROGRAM TO DEVELOP A HIGH-ENERGY DENSITY PRIMARY BATTERY WITH A MINIMUM OF 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT Second Quarterly Report, Oct.–Dec. 1964
William E. Elliott, Shih-liang Hsu, and Warren L. Towle 15 Jan. 1965 83 p ref
(Contract NAS3-6015)
(NASA-CR-54298) OTS: HC $3.00/MF $0.75

Significant emphasis has been placed on studying the behavior of nonaqueous electrolytes in both qualitative and quantitative aspects. The highest conductance of 5.0×10^{-2} ohm^{-1} cm^{-1} was achieved for $NaSbF_6$ in acetonitrile, and $NaPF_6$ in acetonitrile solutions, and the anode-electrolyte combination of calcium and acetonitrile solution appears very promising. Quantitatively, an empirical formula to correlate the conductance with the viscosity, concentration, and the dielectric constant was developed. This enables a prediction of the magnitude of the conductance at a certain concentration within an order of magnitude, provided that the viscosity of the solution and the dielectric constant of the solvent are available. Furthermore, the study of two mixed solvents—acetonitrile + dimethyl cyanamide and ethylene carbonate + propylene carbonate—clearly demonstrates the quantitative effects of the viscosity and the dielectric constant on the conductance of these systems. Author

N65-16745*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT Quarterly Progress Report No. 5, Jul. 15–Oct. 15, 1964
E. E. Hoffman, ed. 30 Dec. 1964 58 p refs
(Contract NAS3-2547)
(NASA-CR-54269) OTS: HC $2.00/MF $0.50

The immediate corrosion test design conditions for a two-loop Cb-Zr facility are (1) boiling temperature, 1900° F; (2) superheat temperature, 2000° F; (3) condensing temperature, 1350° F; (4) subcooling temperature, 800° F; (5) mass flow rate, 20 to 40 lb/hr; (6) vapor velocity, 100 to 150 ft/sec; and (7) average heat flux in the potassium boiler, 50 000 to 100 000 BTU/hr ft^2. Two test loops were completed and a third is under construction, for sequential testing of components and endurance. Loop I, a natural convection loop, was operated for 1000 hours with liquid sodium at a maximum temperature of 2260° to 2380° F. Evaluation electrical components and characteristics and the use of electrical and thermal insulation was done in the Loop I test. Loop II provides for evaluation of single-phase forced-circulation sodium flow components and pressure transducers. The design was completed for a prototype corrosion test loop. This is a two-loop system including the Loop I and II components and a boiler, turbine simulator, and condenser for development and endurance testing of the components in stable operation at the corrosion test design conditions. E.P.V.

N65-16808*# Stanford Univ., Calif. Design Div.
ENERGY STORAGE DEVICES—ELECTROEXPLOSIVE DEVICES Report No. 3
J. L. Harms and P. Z. Bulkeley [1963] 39 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950535)
(NASA-CR-60682) OTS: HC $2.00/MF $0.50

The present state-of-the-art for electroexplosive ignition, actuation, and initiation devices is discussed. Schematic diagrams of several devices are presented. The use of an exploding bridge wire circuit eliminates the primary charge and allows direct ignition of double base propellants, thus leading to miniaturization of the electroexplosive devices. G.G.

N65-16837*# Army Biological Labs., Fort Detrick, Md. Physical Defense Div.
THE EFFECT OF NICKEL-CADMIUM BATTERIES UPON BACTERIAL SPORES Report of Test No. 20-63

Dorothy M. Portner 11 Apr. 1963 7 p
(NASA Order R-35)
(NASA-CR-50246) OTS: HC $1.00/MF $0.50

Nickel–cadmium batteries were tested to determine whether they are self-sterilizing because of their high hydroxide content; if so, they would not require special sterilization treatment for interplanetary flight. Tests were performed on slices of nickel–cadmium batteries contaminated by bacterial spores to determine whether (1) the spore recovery obtained in the presence of the battery was affected by the pH of the diluent (hydrochloric acid and distilled water), (2) spores could be recovered if the nickel–cadmium battery was deliberately contaminated, (3) bacterial inhibition observed in (2) was due to the battery metals diffusing into the diluent and subsequently being carried over into the agar plate, and (4) spores would survive in a nickel–cadmium battery. Results showed that (1) spores could be recovered in either diluent; (2) bacterial growth was inhibited; (3) inhibitory effects were partially overcome by the use of thioglycollate agar; and (4) microorganisms would not survive more than an hour or two in a nickel–cadmium battery. It was concluded from the results of the tests that the nickel–cadmium batteries tested are self-sterilizing. N.E.A.

N65-16888*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BRAYTON CYCLE MAGNETOHYDRODYNAMIC POWER GENERATION WITH NONEQUILIBRIUM CONDUCTIVITY
John E. Heighway and Lester D. Nichols Washington, NASA, Feb. 1965 49 p refs
(NASA-TN-D-2651) OTS: HC $2.00/MF $0.50

Power densities of magnetohydrodynamic generators operating in a Brayton cycle with nonequilibrium conductivity are computed. Helium, neon, argon, and xenon with cesium seed are considered as working fluids in a constant-area, constant-voltage segmented generator operating in the Faraday mode. The generator performance is specified by optimizing the cycle efficiency with respect to load voltage, and by optimizing output power density with respect to seed fraction and operating pressure. The power density is determined as a function of Mach number and magnetic field strength. Argon exhibits the highest power density in the supersonic regime and neon the highest in the subsonic regime for the particular generator and cycle considered. Author

N65-16936# Marquardt Corp., Van Nuys, Calif.
INVESTIGATION OF THE CURRENT DENSITY LIMITATIONS IN A THERMIONIC CONVERTER Technical Summary Report, 1 Nov. 1963–31 Oct. 1964
C. Kaplan and J. B. Merzenich [1964] 25 p refs Presented at the Thermionic Conversion Specialist Conf. NASA-Lewis Res. Center, Cleveland, 28 Oct. 1964
(Contract Nonr-3738(00))
(Rept.-25150; AD-608551) OTS: $2.00

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2. PULSED-DISCHARGE EXPERIMENTS IN A THERMIONIC CONVERTER C. Kaplan p 13–19 refs (See N65-16938 07-03)

N65-16937 Marquardt Corp., Van Nuys, Calif.
XENON ADDITION EXPERIMENT IN A THERMIONIC CONVERTER
C. Kaplan and J. B. Merzenich *In its* Invest. of the Current Density Limitations in a Thermionic Converter [1964] p 1–12 refs (See N65-16936 07-03) OTS: $2.00

A large number of current-versus-voltage curves were obtained, using pure cesium (Cs), and also a cesium–xenon mixture (Cs + Xe). Comparison of the Cs + Xe data with the Cs data shows that the addition of 60 torr of xenon gas to the converter yielded an increase of from 15% to 80% in output power, for a fixed emitter temperature, and a given output voltage. The maximum power output obtained with the Cs + Xe mixture was 8.3 W/cm^2 at an emitter temperature of T_e = 1370°C. The increase in power output appears to be due to a decrease in the internal voltage loss, required for production of ions by volume ionization. A decrease in output was obtained when neon was added to the converter. Author

N65-16938 Marquardt Corp., Van Nuys, Calif.
PULSED-DISCHARGE EXPERIMENTS IN A THERMIONIC CONVERTER
C. Kaplan *In its* Invest. of the Current Density Limitations in a Thermionic Converter [1964] p 13–19 refs (See N65-16936 07-03) OTS: $2.00

Pulsed-discharge experiments were performed with pure cesium (Cs), and with a cesium–xenon mixture (Cs + Xe). A high-current pulse was applied to the converter, followed by rapid switching to lower current levels. The pulsed current–voltage characteristic, obtained by measuring the current and voltage just after the pulse, indicates that the transport losses in the converter are eliminated by the excess positive ions produced during the pulse. The electron current just after the pulse is limited only by the work function barriers; this allows measuring the collector work function under realistic diode operating conditions. The measured collector work function shows the variation with T_c/T_{Cs} (collector temperature/cesium reservoir temperature) measured by other techniques. The decay time of the increased voltage after the pulsed discharge is a measure of the ion lifetime. The data indicate that a two-stage decay process is occurring, which implies the presence of two types of positive ions, Cs^+ and Cs_2^+. The decay time of the faster ion, tentatively identified as Cs_2^+, is longer in Cs + Xe than in Cs. Author

N65-16956# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN IMPROVED THERMIONIC ENERGY CONVERTER Quarterly Technical Report, 1 Oct.–31 Dec. 1964
15 Jan. 1965 33 p
(Contract AT(30-1)-3429)
(QTR-2)

The feasibility of using cesium vapor converters for thermionic power systems was studied, with the main emphases directed toward improved processing techniques, improvement of the heater design, evaluation of the converter performance with radioactive and nonradioactive cesium, evaluation of variable-volume converter performance, life testing of reservoirless converters, and the analysis of converter components. G.G.

N65-16970# Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
DEVELOPMENT OF A PURE-FLUID MISSILE CONTROL SYSTEM Supporting Research Summary Report (Third), FY 64
T. G. Wetheral and J. L. Byrd 1 Dec. 1964 86 p refs
(RG-TR-64-18; AD-455527)

In developing and testing a pure-fluid missile control system, using a modified Little John Rocket as the Test Instrumentation Missile (TIM), the specific objective were to: (1) design, fabricate, and test a proportional and bistable amplifier; (2) study cascaded amplifiers using the water table; (3)

evaluate a state-of-the-art six-stage proportional-pressure amplifier; and (4) fly a test missile with an all-pneumatic roll control system. Qualitative parametric studies with various amplifier configurations were conducted until the configuration was fixed. Due to power-jet oscillations, most of these experiments were difficult to evaluate. The air model was tested at a supply pressure of 2 psig. Testing of this amplifier was difficult, because of the complex relationship between control-port pressure, supply pressure, and output loading. Three six-stage, proportional, pure-fluid amplifiers were given preliminary and static-pressure tests, and the results presented. Author

N65-17063*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
SOME CRITICAL MATERIALS PROBLEMS OF THERMIONIC CATHODE SYSTEMS FOR FISSION-HEAT CONVERSION
L. Yang, R. G. Hudson, F. D. Carpenter, A. F. Weinberg, and S. Langer 8 May 1962 16 p refs Presented at the Symp. on Thermionic Power Conversion, Colorado Springs, 14–16 May 1963 Submitted for Publication
(Contract NAS5-1253)
(NASA-CR-51209; GA-3133) OTS: HC $1.00/MF $0.50

Two types of thermionic emitters have been suggested for the direct conversion of fission heat to electrical energy: (1) uranium-bearing carbides which also function as the nuclear fuels, and (2) refractory metals fueled with uranium containing oxides or carbides. Irrespective of what happens in a reactor, there are certain conditions which have to be met before these emitter systems can be of any practical value. For the carbide emitters, the rate of material loss by vaporization should satisfy the designed life expectancy at temperatures where useful performance is obtainable. For the refractory-metal emitters, the diffusion of the components of the fuels into the metals should not impair their electron-emission characteristics. The purpose of this paper is to analyze these aspects on the basis of existing experimental data, and to discuss the current status and problem areas with regard to the feasibility of these two emitter systems. Author

N65-17184# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE NEW NICKEL–ZINC STORAGE BATTERY
N. A. Zhulidov and F. I. Yefremov 5 Jan. 1965 8 p Transl. into ENGLISH from Vestn. Elektroprom. (USSR), no. 2, 1963 p 74–75
(FTD-TT-64-605/1+2; AD-610270)

The electrochemical principles and the design and construction of a nickel–zinc storage battery are presented. The construction is diagramed, and charge and discharge characteristics are graphed. Various operating characteristics of the battery are given, and comparative data on this type of battery and several other types of battery are tabulated. The advantages of the nickel–zinc battery in cost, weight, and life are enumerated. D.E.W.

N65-17186# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC POWER STATION IN THE COSMOS
Yuriy Marinin 7 Jan. 1965 6 p Transl. into ENGLISH from Sov. Belorussiya (Minsk), 9 Jul. 1963 p 3
(FTD-TT-64-633/1; AD-610356)

The use of nuclear reactors would provide electric energy for space use without the deficiencies and limitations of chemical batteries, solar elements, and radioactive isotopes. To avoid hazards from radioactivity, nuclear reactors could be connected only after reaching a high altitude, would need reliable shielding to protect electronic equipment as well as crew, and would have to be constructed to assure the total burning of all radioactive substances before reentry. If this power source is used for lunar or planetary landing vehicles, radioactive contamination will have to be prevented. R.L.K.

N65-17229# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY First Quarterly Technical Summary Report, Jul. 1–Sep. 30, 1964
30 Oct. 1964 11 p ref
(Contract NObs-90417)
(GEST-2042; AD-609953)

This report describes the development of possible methods of connecting one thermionic diode to the next in a closely spaced series array such as that intended for use in a nuclear fuel element. Author

N65-17232# General Electric Co., Lynn, Mass.
INVESTIGATION OF POWER SOURCES FOR MAN-PACK EQUIPMENT Final Report
T. C. Hovious Griffiss AFB, N. Y., RADC, Dec. 1964 110 p refs
(Contract AF 30(602)-3356)
(RADC-TDR-64-412; AD-610104)

Man-pack power sources were studied using one-to-nine and one-to-one duty cycles at power levels of 10, 25, and 100 W. The results indicated that batteries of the AgZnO type seem best for all power levels at the one-to-nine duty cycle. The fuel cells, although inherently lighter in the 10 W and 25 W design, are not conclusively superior in the 100 W size. W.M.

N65-17233# California Research Corp., Richmond.
AN EVALUATION OF FUEL CELL SYSTEMS FOR MILITARY VEHICLE PROPULSION AND PORTABLE ELECTRIC POWER GENERATION Special Report No. 2
Maurice J. Schlatter 1 Feb. 1965 170 p refs
(Contracts DA-49-186-AMC-149(D); DA-49-186-ORD-929)
(AD-456739)

The following topics were discussed: *Power Systems; Fuel Consumption and Power Densities of Internal Combustion Engines; Fuel Cell Fuel Logistics; System Power Densities and Fuel Consumption for Idealized Fuel Cell Systems; Hydrocarbon Fuel Cell Systems; Low Temperature Direct Hydrocarbon Fuel Cells; High Temperature Direct Hydrocarbon Fuel Cells; Indirect Hydrocarbon Fuel Cell Systems; Steam Reforming of Hydrocarbons to Give Hydrogen for Hydrogen-Rich Mixtures for Fuel Cell Fuel; Comparisons of Gross Efficiencies of Some Indirect Hydrocarbon Fuel Cell Systems; Power Densities and Design of Some Indirect Hydrocarbon Fuel Cell Systems; Palladium Diffusion Hydrogen Separation Applied to Integrated Hydrogen Steam Reformer–Fuel Cells;* and *Integrated Hydrocarbon Partial Oxidation Unit—Fuel Cell Power Systems.* G.G.

N65-17239# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Report, 1 Sep.–30 Nov. 1964
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and R. E. Stickney 15 Dec. 1964 24 p refs
(Contract AF 33(615)-1083)
(QTPR-5; AD-610673)

Cycle studies of the liquid-metal MHD system have indicated that favorable cycle efficiencies are associated with high performance or efficient operation of the condensing ejector. Schematic diagram of the ejector is presented and high performance operation discussed. The measurement of thermal

conductivity of cesium vapor is also reported. Experimental values are plotted vs temperature. Also, the MHD induction machine is discussed in terms of attainable overall efficiency, optimum operating regime, and design parameters. E.E.B.

N65-17257*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Semiannual Report
M. Klein and E. Findl 1 Feb. 1965 55 p ref
(Contract NAS3-2781)
(NASA-CR-54279; EOS-4110-2Q-2) OTS: HC $3.00/MF $0.50

Design problems on the 75-watt electrolytically regenerative fuel cell were corrected. The 75-watt unit was successfully continuously cycled at levels to 90 watts. Performance data and details of single and multicell units are presented. Author

N65-17377# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT POWER ENGINEERING (SELECTED ARTICLES)
R. Ye. Zaryankin et al 18 Feb. 1964 31 p refs Transl. into ENGLISH from Teploenerg. (Moscow) no. 2, 1963 p 41–45, 45–50
(FTD-MT-63-192; AD-606764)

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1. INVESTIGATION OF EXHAUST PIPES OF CONDENSATION STEAM TURBINES A. Ye. Zaryankin and A. A. Kryglenkov p 1–12 refs

2. EXPERIMENTAL INVESTIGATION OF HYDRAULIC RESISTANCE OF THE FEEDER OF A SYSTEM AIR COOLING OF THE ROTOR OF A GAS TURBINE F. Z. Rauner p 13–29 refs

N65-17385# Naval Research Lab., Washington, D. C. Technical Information Div.
DIRECT ENERGY CONVERSION LITERATURE ABSTRACTS
Apr. 1964 123 p refs
(AD-601224) OTS: $2.75

A collection of references is presented covering the current literature on thermoelectricity, thermionic emission, photoelectric processes, magnetohydrodynamics, electrochemical processes, energy storage, and energy sources.
Author

N65-17401# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Pigments Dept.
HIGH TEMPERATURE THERMOELECTRIC GENERATOR Quarterly Report, Period Ending Jun. 30, 1964
W. T. Hicks [1964] 10 p
(Contract NObs-88639)
(AD-604905)

Degradation of module performance due to air oxidation of semiconducting elements has now been overcome by development of an appropriate sealing technique and use of O_2 getters within the module. Some compression of the modules will be required to assure adequate heat flow at the hot junction. Design of the 300-watt prototype generator is complete and fabrication is in progress. Author

N65-17405# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF A LOW-WORK-FUNCTION COLLECTOR FOR THERMIONIC ENERGY CONVERTERS Annual Technical Summary Report No. 2, 15 Dec. 1963–15 Oct. 1964
W. B. Hall and R. J. Hill [1964] 71 p refs
(Contract Nonr-4012(00)-FBM)
(AD-608913)

The construction and evaluation of a unique device for studying collectors of thermionic converters operating in the Ball-of-Fire mode are described. The test vehicle contains one emitter and a rotating disc on which six collectors are mounted. Without disturbing the vacuum condition, each collector may in turn be brought adjacent to the emitter, and the electrode combination can be operated as a converter. The emitter temperature, collector temperature, cesium reservoir temperature, and interelectrode spacing may all be independently varied and measured. A porous rhenium collector was found to be best in terms of both output voltage and output power. The stability of this kind of collector over a period of time was examined, and design recommendations are made for practical converters on the basis of the findings.
Author

N65-17414*# Bendix Corp., Southfield, Mich. Research Labs. Div.
RESEARCH ON THERMAL STORAGE FOR ADVANCED SOLAR POWERED DYNAMIC SPACE POWER PLANTS Final Report
Harlow W. Schwartz, James H. Tarter, and Donald J. Wille 24 Jul. 1964 80 p refs
(Contract NOw-63-0676-c)
(Rept.-2656; AD-452164)

The feasibility of using lithium fluoride as a thermal storage medium in solar dynamic space power systems was explored. The major emphasis was on the experimental investigation of the compatibility of materials of construction with lithium fluoride and on the construction and testing of liquid metal boilers to evaluate various means of extracting thermal energy from the molten salt. It was concluded that lithium fluoride is an acceptable thermal storage medium. In the material compatibility tests, containers constructed of different alloys filled with lithium fluoride were thermally cycled around the melting temperature of the salt. The heat extraction tests utilized NaK 78 tubular boilers of various configurations. The finned tube units had the highest heat flux capability. A brief literature survey was performed that established the significant thermal properties of lithium fluoride. One significant property on which data are lacking is the thermal conductivity of the molten salt. An attempt was made to experimentally obtain this value. Recommendations for further work on the evaluation of the feasibility of lithium fluoride as a thermal storage medium include the performance of a materials compatibility test of 10000 hours duration, testing of additional boilers, heat extraction tests using a gaseous medium in place of a boiling liquid metal, and experimental evaluation of the thermal conductivity of the molten salt. Author

N65-17454*# Astropower, Inc., Newport Beach, Calif. Missile and Space Systems Div.
INORGANIC ION EXCHANGE MEMBRANE FUEL CELL Quarterly Progress Report for the Period Ending 10 Jan. 1965
C. Berger and M. P. Strier Jan. 1965 57 p refs
(Contract NAS3-6000)
(NASA-CR-54280; SM-46221-Q2) OTS: HC $3.00/MF $0.50

The development and evaluation of zirconium phosphate ion exchange membranes for hydrogen–oxygen fuel cell application were continued. Fuel cell, and membrane composition and fabrication studies were carried out together with accompanying transverse strength, resistivity and hydrolytic stability measurements. It was found possible to increase the transverse strength to as high as 9520 psi by saturating the sintered membrane with phosphoric acid through three impregnations, each being followed by sintering at 500° C for 5 minutes. R.L.K.

N65-17467# Inland Testing Labs., Dayton, Ohio. Tech-Center Div.
INVESTIGATIONS LEADING TO THE DEVELOPMENT OF THE OPTIMUM METHOD(S) FOR CHARGING SEALED NICKEL-CADMIUM BATTERIES Final Report, 1 Oct. 1962–30 Sep. 1963 and Addendum to Final Report, 4 May–4 Oct. 1964
I. F. Luke and R. L. Koesters [1964] 112 p
(Contract DA-36-039-SC-90823)
(Rept.-4; AD-456387)

Experiment designs, test data, analyses and results for investigations of constant current and constant potential charging at 125°, 75°, −10°, and −40° F for cells at different initial states of charge are presented. Results of a preliminary investigation of pulse charging at −40° F are also presented. The experiments include test variables of ambient cell temperature, charging period, charging potential, percent input, initial state of charge, cell size and discharge rate depending upon the type of charging method employed. Cells of type BB 412( )/U and BB 440( )/U were used in these investigations. From the limited data obtained, pulse charging of either cell type at −40° F with average 1-hour charge rates does not appear feasible. However, results following pulse charging of the Type BB 440( )/U cells at −40° F with an average 4-hour charge rate were comparable to those with constant potential charging of these cells for four hours at −40° F. Author

N65-17471# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY, VOLUME II Final Technical Summary Report
30 Jun. 1964 114 p refs
(Contract NObs-88578; ARPA Order 219)
(GEST-2035; AD-445774)

An emitter–collector spacing configuration was designed, fabricated, and tested. The tests proved the feasibility of the chosen configuration and the compatibility of the materials in a cesium atmosphere at high temperatures. Series-connected thermionic converters were tested. It was determined that the lower emitter and upper collector required further electrical isolation. This could be accomplished by a ceramic coating on the lower surface of the collector. The diffusion of urania through tungsten was found to be almost negligible, but was affected by variations in temperature. The data obtained show that this diffusion should not present any serious problems in the use of these materials in thermionic applications. Author

N65-17474# General Electric Co., Pleasanton, Calif.
RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY Second Quarterly Letter Report, 30 Sep.–29 Dec. 1964
John E. Van Hoomissen 29 Dec. 1964 6 p
(Contract NObs-90496; ARPA Order 219)
(AD-455808)

A program to develop a nuclear thermionic electrical generating system is reported. Three major areas are described, viz UO_2-refractory metal reaction kinetics, insulator materials, and ceramic-to-metal seals. The diffusion testing for uranium in a powder-metallurgy molybdenum capsule was extended to 1700 hours. The selection of a laboratory to perform oxygen analyses of molybdenum samples is described, and data are tabulated from the first determinations of oxygen, nitrogen, and carbon in the molybdenum. A Knudsen cell attachment to a mass spectrometer was built. Achievements are discussed in the areas of cesium-resistant metallizing, multilayered cermets, metal-to-metal joining, and cesium and vacuum life testing. D.E.W.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-16404 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REACTIVITY STATE OF ANIMAL ORGANISM AFTER SUBJECTION TO CERTAIN SPACE-FLIGHT FACTORS
V. V. Antipov, V. I. Davydov, E. F. Panchenkova, P. P. Saksonov, and G. A. Chernov *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 234–246 refs (See N65-16391 07-30)

Data are given on the changes in the reactivity of animals of physical exertion following subjection to g-forces, the combined action of acceleration and X-irradiation, and irradiation by 120-MeV protons. The shifts detected indicate a persistent change in the stability to physical load following subjection to acceleration, ionizing radiation and combinations of these factors. The change in the tolerance of centrifuged animals to physical load correlates with ceruloplasmin shifts in the blood serum. Author

N65-16405 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATIONS OF THE INFLUENCE OF LANDING IMPACT g-FORCES ON THE ANIMAL ORGANISM
S. A. Gozulov, G. P. Mirolyubov, N. N. Popov, and N. I. Frolov *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 247–257 refs (See N65-16391 07-30)

The results of experimental studies of the effect of landing-impact g-forces on animals are reported. The manner in which morphological changes in the internal organs and the degree of disturbance to the functions of the cardiovascular system depend on the magnitude of the disturbance is determined. Author

N65-16429*# Florida State Univ., Tallahassee. Dept. of Psychology
PERIPHERAL MECHANISMS OF HUMAN TEMPERATURE SENSITIVITY Status Report No. 5, 1 Sep. 1963–29 Feb. 1964
D. R. Kenshalo [1964] 4 p refs
(Grant NsG-148-61)
(NASA-CR-56192) OTS: HC $1.00/MF $0.50

In investigating the effect of variables which affect the temperature threshold of the skin when adapted to temperatures between 27° C and 42° C, the menstrual cycle was manipulated by the use of oral contraceptives, and the link between the change in threshold and a change in the hormone balance of the female was clearly indicated. In concurrent measurement of changes in the cutaneous vascular activity and the cool threshold as a function of the temperature to which the skin is adapted, the effect of adrenalin iontophoresis, increasing both the warm and cool thresholds, was interpreted to mean that constricting smooth muscles directly affects the thermal threshold. In investigations of the spatial summation of warm stimuli to produce a threshold response, equations fitted to the curves of areal summation on the forehead, forearm, and back show that the equations for the curves have the general form

of log I + K log A = a constant, where I is intensity, A is area, and K is a constant. In an investigation of the temporal course of adaptation to thermal stimuli, a method was devised in which the subject, by moving a key, can keep the stimulation just noticeably warm. R.L.K.

N65-16430*# Virginia Univ., Charlottesville. Medical College
[MECHANISMS OF CONTROL OF CEREBRAL CIRCULATION] Progress Report
[1962] 2 p ref
(Grant NsG-156-61)
(NASA-CR-50682) OTS: HC $1.00/MF $0.50

Experiments have been performed, using rapid manual sampling from the jugular bulb, which allow analysis of the simultaneous pattern of response of arterial CO_2 tension, cerebral blood flow, as indicated by cerebral $(A\text{-}V)O_2$, and jugular venous PCO_2 to a given level of inspired CO_2. The arterial PCO_2 takes approximately 2.5 to 3 minutes to achieve a plateau value. The jugular venous PCO_2 follows the arterial closely but may lag behind as much as one minute. Cerebral blood flow achieves its peak level in from 0 to 120 seconds after the arterial peak PCO_2 is reached, or as much as 4 minutes after initial exposure to carbon dioxide. The arterial lag time might well be primarily a result of the "buffer" effect of the lungs. The further delay of cerebral blood may well be due to the hysteresis phenomenon which is not of comparable magnitude in every individual. Observations of the overall pattern in these experiments reveal that while arterial and jugular CO_2 tensions are similar in their behavior, the changes in blood flow correspond more closely to the fluctuations in arterial CO_2 tensions. I.v.L.

N65-16432*# Republic Aviation Corp., Farmingdale, N. Y. Space Environment and Life Sciences Lab.
STUDY OF THE NORMAL FECAL BACTERIAL FLORA OF MAN Quarterly Progress Report, Jul.–Sep. 1963
Lorraine S. Gall 7 Oct. 1963 5 p
(Contract NASw-738)
(NASA-CR-52232) OTS: HC $1.00/MF $0.50

Anaerobic and aerobic cultures of the normal fecal bacterial flora of man were studied. The preliminary results of the anaerobic culturing of human feces showed that strict anaerobes are present in approximately one trillion per gram of feces or more. These anaerobes are of diverse types, and each man carries a variety of strictly anaerobic organisms. Observations of gram stains revealed, in addition to the usually described bacteria, a predominance of extremely tiny rods and cocci, both gram negative and gram positive. The results of aerobic culturing showed that less than a billion aerobes were found in each sample. Five subjects had less than one million aerobes per gram of feces, and all but two showed less than 100 million per gram. Two subjects had roughly 200 to 550 million aerobes. These results point out the striking predominance of the strict anaerobes over the aerobes. I.v.L.

N65-16436*# Northrop Space Labs., Hawthorne, Calif. Bioastronautics Lab.
BIOLOGICAL AND PHYSIOLOGICAL STUDIES OF *PEROGNATHUS* (POCKET MICE) Fifth Quarterly Status Report, 1 Mar.–31 May 1963
R. G. Lindberg, R. M. Chew, and P. Hayden [1963] 20 p refs
(Contract NASr-91)
(NASA-CR-50597) OTS: HC $1.00/MF $0.50

Results of investigations of biological rhythms in pocket mice have led to the following conclusions: (1) Pocket mice (*Perognathus longimembris* and *Perognathus inornatus*) demonstrate a circadian metabolic rhythm. (2) This rhythm is obviously in agreement with the natural photoperiod. The mice, which are nocturnally active under natural conditions, show metabolic lows during daylight hours and metabolic highs during nighttime hours. This occurs even when animals are in continuous darkness for 6 to 7 days. (3) Starvation and low ambient temperatures accentuate the amplitude of the rhythm so that there is an occurrence of deep hypometabolism almost every day. (4) The approximate 24-hour period of the rhythm is not altered by keeping individual pocket mice in continuous darkness, isolating them from sound, exposing them to air with 4.5% CO_2 or to atmospheres saturated with water vapor, or exposing them to 1400 r Co^{60} irradiation. (5) There is a tendency for the rhythms of starved mice, when kept in groups, to become synchronized, and there is also a tendency for some individuals to "drop out of the rhythm" for one or more days by remaining deeply hypometabolic. These conclusions have led to the preliminary design of a biological experiment in space. This experiment will study the effect of extraterrestrial residence on the circadian metabolic rhythm of pocket mice (*Perognathus longimembris*). I.v.L.

N65-16478*# Resources Research, Inc., Washington, D. C.
RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE Quarterly Progress Report No. 10
Gilbert V. Levin et al 25 Sep. 1963 58 p refs
(Contract NASr-10)
(NASA-CR-55535) OTS: HC $3.00/MF $0.50

Pure cultures and microorganisms in soils continued to yield positive responses when cultured in a labeled M8 medium containing formate (0.13 mM, 3.3 μc/ml)–glucose (0.21 mM, 1.0 μc/ml)–lactate (0.44 mM, 2.2μc/ml). The study of acrolein for use as an antimetabolite showed it to be heat stable and chemically unreactive with the labeled substrates, but not completely effective as an inhibitor in the concentration employed. A preliminary photosynthetic determination was carried out with the alga *Scenedesmus quadricauda*. Five tests were performed with the Gulliver space probe. The results of the tests are presented. R.T.K.

N65-16483*# Naval School of Aviation Medicine, Pensacola, Fla.
ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE Progress Report No. 3, 1 Jun.–31 Aug. 1963
Hermann J. Schaefer [1963] 2 p ref
(NASA Order R-75)
(NASA-CR-51826) OTS: HC $1.00/MF $0.50

A method for improving the resolution of the linear energy transfer (LET) spectrum of heterogeneous proton beams at the upper end of the LET scale is described. The spectrum analysis covers the entire LET range of protons. Application has been confined to one typical flare-produced proton spectrum ($2g/cm^2$ and $8g/cm^2$) for the Watt spectrum of neutron recoil protons. Results show that though the fractional dosage effected at LET values about the Bragg peak generally remains at a few percent of the total ionization dosage, it changes markedly depending on the depth in tissue analyzed. Consequently, a complete measurement of the radiation load from a solar proton beam requires separate determination of total dosage and of the second maximum at the upper end of the LET scale. R.E.S.

N65-16484*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE Progress Report No. 2, 1 Mar.–31 May 1963

Hermann J. Schaefer [1963] 2 p
(NASA Order R-75)
(NASA-CR-50471) OTS: HC $1.00/MF $0.50

The evaluation of emulsion packs flown on the MA-8 mission showed a pronounced directional effect of low and medium energy protons which were picked when the vehicle passed, on three of its six orbits, through the Capetown anomaly. This finding led to an investigation as to what extent the local hardware in the capsule would be responsible for the directionality of the radiation field inside. A greatly simplified model of a Gemini capsule, consisting of a conical part of low thickness with a spherical heat shield of large thickness as base, was assumed, and the radiation field inside was analyzed for three basic types of proton spectra. The distribution of the "air" dose inside the ship as well as the dosage field within a spherical target assumed at different locations inside the ship was determined. Results show that even for the greatly simplified model, a highly structured dose distribution prevails inside, due to different shield thicknesses offered to the incoming radiation for different directions. Furthermore, the dose distribution within a compact target (human body) within the ship strongly depends on location and orientation. The magnitude of local air dose at a given location does not allow direct inferences on the dosage distribution that would develop in a compact target at that location. For instance, the dose to the lenses of the eyes changes only slightly with directional orientation of the head in the nose tip, but changes by a factor of two close to the heat shield. Quantitatively, the effects of low and medium energy protons depend on the steepness of the energy spectrum. They are more pronounced for the steeper spectra, such ast the ones reported for flare produced protons, but they are still quite significant, even for the smallest spectral slope reported for Van Allen Belt protons. The effects are completely reversed for the spectrum of the ordinary cosmic-ray beam due to the buildup phenomenon.

I.v.L.

N65-16485*# Naval School of Aviation Medicine, Pensacola, Fla.
CONDUCT RESEARCH ON THE EFFECT OF VERY STRONG FIELDS AND OF MAGNETIC FIELD-FREE ENVIRONMENTS ON MAN AND ANIMALS Progress Report, 1 Feb.–30 Apr. 1964
D. E. Beischer [1964] 2 p
(NASA Order R-39)
(NASA-CR-56356) OTS: HC $1.00/MF $0.50

Four male volunteers were exposed to very low magnetic fields for 10 days. Also, as controls, two men were restricted to the same living conditions as the test subjects. Previous observations of flicker-fusion studies were confirmed. The scotopic flicker-fusion limit was reduced in all subjects during the 10 day exposure period by an average of 30% of its original value. Values returned gradually to control values during the after exposure control period. E.E.B.

N65-16486*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
CONDUCT RESEARCH ON THE EFFECT OF VERY STRONG FIELDS AND OF MAGNETIC FIELD-FREE ENVIRONMENTS ON MAN AND ANIMALS Progress Report, 1 Aug.–31 Oct. 1963
D. E. Beischer [1963] 3 p
(NASA Order R-39)
(NASA-CR-52453) OTS: HC $1.00/MF $0.50

A new procedure for the exposure of animals to very high magnetic fields was tried in coils used for pulse forming of metals. The experiments were made in a field of maximal 300000 gauss acting for a few microseconds during the discharge of the condenser. Mice survived this treatment, which is able to form metals of desired shapes. A human hand held a short distance from the coil feels a prickling sensation. Operating personnel described an involuntary stretching of the arm and considerable pain in the abdomen if this part of the body came in close proximity to a coil during the pulse discharge. These observations are of great interest since pulse forming is in the progress of being developed as a tool for metal forming in space. Also, the effects of the magnetic field on cell division of sea urchin eggs and on the heart rate of mammals were studied. The first stages of cell division of the eggs were delayed in fields of 140000 gauss. The heart rate of a squirrel monkey changed in rate and regularity during changes of magnetic fields of maximal 70000 gauss. I.v.L.

N65-16487*# Naval Medical Research Inst., Bethesda, Md.
[BASIC PHYSIOLOGICAL MECHANISMS WHICH DEFEND THE HUMAN BODY AGAINST HEAT AND COLD AND THE EXTENT AND EFFICIENCY OF ENERGY TRANSFORMATIONS IN THE HUMAN BODY AND IN ISOLATED BODY CONSTITUENTS AT THE MOLECULAR LEVEL] Quarterly Progress Report, 1 Jul.–30 Sep. 1963
T. H. Benzinger [1963] 7 p refs
(NASA Order R-38)
(NASA-CR-52183) OTS: HC $1.00/MF $0.50

Studies were continued in human energetics, including temperature regulation and the uses of gradient layer calorimetry, and in molecular energetics, including chemosynthesis. A tabular presentation is included for temperature stimuli, thermoreceptor firing rates, and regulatory responses in heat loss or heat production. J.E.T.

N65-16493*# General Mills, Inc., Minneapolis, Minn.
[RESEARCH TO DETERMINE THE EXISTENCE AND IDENTITY OF VIABLE MICROORGANISMS IN THE STRATOSPHERE] Quarterly Status Report No. 3, 19 Sep.–20 Dec. 1963
V. W. Greene [1963] 6 p
(Contract NASw-648)
(NASA-CR-53951) OTS: HC $1.00/MF $0.50

In order to improve postimpact protection, new anticontamination seals were developed consisting of nonabsorbent cotton plugs wrapped in gauze; these plugs were unaffected by autoclaving, pressure changes, or stratospheric temperatures, and performed well during altitude chamber tests. Sampling instruments were evaluated with regard to their sterilizability by autoclaving, their aerodynamic particle-trapping efficiency, and their postimpact contamination characteristics. The analytical results of the third flight are presented in which three samplers were used for measurement of the stratospheric contamination level and one sampler for flight control. The maximum limits of the contamination levels were established as less than 2×10^{-4} organisms per ambient cu ft at altitudes between 90 and 60 kft, and less than 1×10^{-3} organisms per ambient cu ft at altitudes between 60 and 40 kft. D.S.G.

N65-16497*# Resources Research, Inc., Washington, D. C.
RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE Third Annual Progress Report
Allen H. Heim 30 Mar. 1964 170 p refs
(Contract NASr-10)
(NASA-CR-56214) OTS: HC $5.00/MF $1.00

Gulliver III, the third model of the instrument designed to detect extraterrestrial life, successfully detected terrestrial microbial life in 12 field tests during the year. Four of the

testing sites, specifically selected for their severe, adverse, environmental conditions, were Sheep Mountain, in the White Mountain Range of California, which was cold, rocky, barren terrain at an altitude of 12 000 ft; Death Valley, California, which provided an arid, sandy environment; the salt encrusted desert flats of the Salton Sea in California; and Orange, Virginia, with its hard, iron-rich, clay surface. All of these extreme natural environment tests yielded good, positive responses in relatively short time periods. Work is also reported on the culture medium, on test microorganisms and responses, on anaerobic determinations, on other biological subjects, and also on instrumentation. D.E.W.

N65-16593*# National Aeronautics and Space Administration, Washington, D. C.
CHANGES IN THE REGIONAL CIRCULATION IN PATIENTS WITH LESIONS OF THE MAIN BLOOD VESSELS OF THE HEAD (ACCORDING TO PLETHYSMOGRAPHIC AND RHEOENCEPHALOGRAPHIC DATA) [IZMENENIYA REGIONARNOGO KROVOOBRASHCHENIYA PRI PORAZHENIYAKH MAGISTRAL'NYKH SOSUDOV GOLOVY (PO DANNYM PLETIZMOGRAFII I REOENTSEFALOGRAFII)]
Kh. Kh. Yarullin Feb. 1965 12 p refs Transl. into ENGLISH from Klin. Med. (USSR), no. 9, 1963 p 61–67 Presented at the 2d Soviet-Romanian Sci. Congr., Bucharest, Sep. 1962 (NASA-TT-F-295) OTS: HC $1.00/MF $0.50

The characteristics of the circulation in the temporal and orbital regions were studied by pneumophotoplethysmography in 70 patients who had lesions of the main vessels of the head (carotid and vertebral arteries). All patients were also subjected to rheoencephalography to evaluate the cerebral circulation. In the great majority of patients with complete carotid obstruction due to thrombosis, the orbital plethysmogram often showed a distinct decrease in the pulse and spontaneous wave amplitudes with a simultaneous increase in the temporal plethysmographic pattern. Rheoencephalograms also showed a sharp decrease in the pulse wave amplitude on the side of the the obstructed carotid artery. All of these signs were most distinct during the first few months following an acute cerebral infarct due to thrombosis, and usually correlated with a drop in retinal pressure. Plethysmographic and rheoencephalographic asymmetry was also noted in cases of internal carotic artery stenosis. Rheoencephalography and especially ocular plethysmography can apparently reveal the slightest and earliest symptoms of insufficiency in the system of the affected internal carotid artery. In patients with lesions of the basilar-vertebral artery system, distinct asymmetry was observed only in the temporal plethysmographic patterns. This asymmetry was particularly marked in cases of combined vertebral and carotid artery lesions. Author

N65-16598*# National Aeronautics and Space Administration, Washington, D.C.
EXTRATERRESTRIAL LIFE, A BIBLIOGRAPHY. PART I: REPORT LITERATURE, 1952–1964
Sep. 1964 80 p refs
(NASA-SP-7015, Pt. I) GPO: HC $0.45; OTS: MF $0.75

Although this bibliography is primarily concerned with the general subjects of extraterrestrial life and exobiology, topics that are directly pertinent to the search for extraterrestrial life are included. Among these are the origin of life on earth, the suitability of other planets for the development of indigenous life, the possibility of intelligent extraterrestrial life forms, techniques and instrumentation for the detection of extraterrestrial life, the chemical basis of life including the synthesis of organic compounds from simple precursors, and terrestrial contamination of spacecraft. Several references, which describe the examination and analysis of meteorites and the relevance of such studies to the subject of extraterrestrial life, are also presented. Each entry consists of a standard bibliographic citation and an annotation in the form of an abstract or a brief descriptive notation. Entries are listed in reverse chronological order, with the most recent references appearing first. A subject index, a personal author index, a corporate source index, and a contract number index are provided. Author

N65-16601# Air Force Academy, Colo.
PROCEEDINGS OF THE FIRST ANNUAL ROCKY MOUNTAIN BIOENGINEERING SYMPOSIUM
[1964] 301 p refs Symp. held at AF Acad., Colo., 4–5 May 1964; sponsored jointly with IEEE
(AD-450818)

Symposium papers on bioinstrumentation, search for extraterrestrial life, biodynamics, biological mechanisms, physiology and medicine, and bioengineering education. For individual titles see N65-16602—N65-16630.

N65-16604 Nebraska Univ., Lincoln.
THE MAGNETOCARDIOGRAM
Robert A. Stratbucker, Clyde M. Hyde, and Jerald Varner *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 26–33 refs (See N65-16601 07-04)
(Grant PHS-HE-0845801)

The recording of the magnetic signal associated with cardiac electrical activity was demonstrated. A mathematical relationship between the electrocardiogram and the magnetocardiogram was derived which shows good agreement between theoretical and experimentally observed results. The equations were modified to include the case of a magnetic sensing device located exterior to the body. Under these conditions the contribution of displacement currents is considered and it is shown that for the cardiac electrical conditions existing in the human body the magnetic field on the chest wall is about 10^{-15} gauss. Assuming in this case both a high permeability magnetic pickup path (i.e., $\mu > 10^4$) and windings in excess of 10^6 turns, it would be possible to record an induced emf of from 10^{-5} to 10^{-4} volts during ventricular depolarization. Author

N65-16605 Martin Co., Denver, Colo. Life Sciences Dept.
BIOPHYSICAL MONITORING OF EXPERIMENTAL ANIMALS
Harry A. Gorman and Roger B. Grau *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 34-48 (See N65-16601 07-04)

This paper describes and illustrates methods of monitoring biophysical parameters in experimental animals by miniature back-pack radio, by hardwire telemetry, and by transducer–transmitter systems. They have been developed to provide radio telemetry of physiological parameters such as electroencephalography, electrocardiography, electroculography, respiration, blood pressures, and temperatures. These telemetry principles and electronic measuring techniques were produced by teaming the disciplines of engineering and medicine. Author

N65-16606 Baylor Univ., Houston, Tex. Div. of Biomedical Engineering
A NUMERICAL INDICATOR FOR INDIRECT SYSTOLIC AND DIASTOLIC BLOOD PRESSURES
L. A. Geddes and J. Canzoneri (Houston Univ.) *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 49–55 refs (See N65-16601 07-04)

A device for numerically indicating systolic and diastolic blood pressures using the auscultatory method was developed. It employs the electrocardiogram R wave as an interrogating signal to actuate logic circuits to inquire for the presence of Korotkoff sounds at specified times during the deflation cycle of the arm-occluding cuff. Performance data and circuit modules are described by the authors. Author

N65-16607 Minnesota Univ., Minneapolis. Dept. of Physical Medicine

DEVELOPMENT OF AN ELECTRICAL IMPEDANCE PLETHYSMOGRAPH SYSTEM TO MONITOR CARDIAC OUTPUT

R. Patterson, W. G. Kubicek, E. Kinnen, D. Witsoe (Rochester Univ.), and G. Noren *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 56–73 refs (See N65-16601 07-04)

(Contract AF 41(657)-403; Grants NIH G-FR-05085-01; VRA-RT-2)

A method was developed that apparently measures pulmonary blood volume changes over the cardiac cycle. By measuring the electrical impedance changes on the surface of the thorax between one electrode band placed around the neck and one band placed around the lower portion of the thorax, pulmonary blood flow values were computed. The system was developed in three phases: (1) establishing an electrode arrangement and relationship to meet certain criteria that were felt necessary to quantitatively measure cardiac output; (2) determining the probable source of the impedance changes that were observed during the cardiac cycle; (3) modifying the plethysmographic system of phase one, developing a new relationship between the impedance variation and the cardiac output, and then correlating the impedance measured cardiac output with the Fick method of measuring cardiac output on 26 children with congenital heart defects. Author

N65-16608 Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology

EXOBIOLOGY

Frank B. Salisbury *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 75–83 refs (See N65-16601 07-04)

Theories on the origin of life, and the presence of organic materials in meteorites suggest the existence of some form of extraterrestrial life, especially on Mars. The phenomena of the dark markings on Mars with their extensive and rapid changes are attributed to unknown plants that are different from our earth vegetation in both physiology and morphology. The Martian canal system, the existence of the two small satellites that revolve in near circular, equatorial orbits around Mars, and the observed short flashes of brilliant light on the Mars surface are assumed to be products of intelligence. G.G.

N65-16609 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SYSTEMS CONSTRAINTS ON THE SEARCH FOR EXTRATERRESTRIAL LIFE

Dennis H. La Croissette *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 84–87 refs (See N65-16601 07-04)

The most severe systems constraints imposed on the life detection instrumentation of a planetary landing capsule are (1) the limitation in the data rate to below 10 bits per second; (2) the relatively low scientific payload weight; and (3) the extreme impact which the capsule will sustain. The major problem of sterilization of the capsule to prevent contamination of the planet by terrestrial organisms may be solved by thermal soakage of the instrumentation at 135° C for 24 hours and resterilization of the exposed surfaces by a 9-to-1 mixture of ethylene oxide and freon. G.G.

N65-16611 Rochester Univ., N. Y. Dept. of Biology

PRINCIPLES OF OPTICAL MEASUREMENTS APPLIED TO BIOLOGICAL GROWTH IN THE *WOLF TRAP*

Charles R. Weston *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 99–109 ref (See N65-16601 07-04)

The search for life on Mars will initially be directed toward detection of microorganisms. The relative concentration of microorganisms in a suspension can be estimated by measuring either the attenuation of a beam of light that passes through the suspension or the intensity of the light scattered by the organisms. The measurement of the scattered light, nephelometry, was selected to measure the growth of organisms in the Wolf Trap because of its inherently greater sensitivity. With the present optics in the two chambers of the engineering breadboard, the Wolf Trap gives a reliable signal at approximately 10^5 bacteria per ml. The breadboard is controlled from a battery-operated portable console that supplies power, simulates spacecraft interface functions, and provides a convenient method of monitoring the data. The entire breadboard can be heat sterilized at 145° C for 24 hours in line with the sterilization requirement for Martian landers. Author

N65-16612 Air Force Systems Command, Brooks AFB, Tex.

TUTORIAL SESSION IN BIODYNAMICS

John P. Stapp *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 113–122 (See N65-16601 07-04)

The relation between axis of orientation of the body to impact forces on a sled accelerated on rails into a water inertia brake, and the physiological and anatomical responses to limits of tolerance, injury and fatality were investigated on 58 human subjects and three animals. Seven different configurations of impact rate, duration, and magnitude simulated various types of landing surfaces comparable to the anticipated parachute landing impacts of the Apollo space cabin. A limit of 25 peak G at less than 2000 G per second onset and more than 80 millisecond durations was established for 16 different body positions tested. Inflated air cushions on each side of the head rest are recommended to prevent hyperflexion of the neck. G.G.

N65-16615 Purdue Univ., Lafayette, Ind. School of Aeronautical and Engineering Sciences

A MULTIPLE DIPOLE MODEL OF THE HUMAN HEART

V. J. Eckelkamp and P. E. Stanley *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 147–165 refs (See N65-16601 07-04)

Bioengineering problems to develop a simple electrical model of the heart are discussed. In this analysis, a homogeneous conducting sphere, representing the human torso to a first approximation, is used to calculate the center of electrical activity within the body, and four current dipoles were used to simulate the four anatomical sections of the heart. The actual location and orientation of the dipoles was obtained from a study of the electrophysiology of the heart as well as the results obtained. The moments of each dipole were optimized to achieve the least square error, and exploratory points were used to find the bipolar lead potentials. It was found that the developed model has little clinical value at present. The location of the dipoles appears to be a critical parameter. G.G.

N65-16616 Marquette Univ., Milwaukee, Wis. Dept. of Electrical Engineering

ELECTRICAL AXIS OF THE FETAL HEART

Saul D. Larks *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 166–174 refs (See N65-16601 07-04) (Grant PHS-G-HD-00558-03)

A method of calculating the electrical axis of the fetal heart is presented. It is shown that the mean value of the fetal cardiac electrical axis is 134 degrees. The mean value of 134 degrees is consistent with the relatively important role played by the right side of the fetal heart in intrauterine life. The electrical axis of the fetal heart should be utilized as a tool for the study of cardiac development, for the assessment of fetal well-being, for identification and study of congenital cardiac malformation, as well as for the investigation of drug effects upon the developing human fetus. Author

N65-16617 Colorado State Univ., Fort Collins. Dept. of Physiology

SOME PROBLEMS IN RECORDING THE ELECTROENCEPHALOGRAM DURING ELECTROANESTHESIA

Reginald A. Herin and R. John Morgan *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 175–186 refs (See N65-16601 07-04)

At times, especially at low current levels the EEG can be recorded during electroanesthesia. At other times a periodic wave pattern is obtained which has the same frequency as the EKG but a modified shape. The periodicity may occur at low as well as high current levels and at times is more pronounced than shown in the tracings. Investigation into this phenomenon is continuing. Author

N65-16622 Air Force Academy, Colo.

DESIGN OF A MULTIPLE CHANNEL PHYSIOLOGICAL TELEMETRY SYSTEM

Richard J. Gowen and Alfred Mateczun, Jr. *In its* Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 227–232 refs (See N65-16601 07-04)

Several modulation systems for a telemetry package were considered for their application in physiological mobile monitoring systems, and pulse duration modulation was found to be feasible for a miniature telemetry system in terms of size, complexity, range, reliability, and power requirements. This system adapts to a digital-type design that makes it possible to break it up into modular functional blocks. This modular system provides versatility and servicability of the transmitter package. G.G.

N65-16624 Colorado Univ., Denver

DEVELOPMENTAL DISTURBANCES OF VERTEBRATE EMBRYOS INDUCED BY LASER RADIATION

Joseph C. Daniel, Jr., Kenneth R. Lang, and Frank S. Barnes *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 240–250 refs (See N65-16601 07-04)

Vertebrate eggs of several different kinds were subjected to laser beams to study the effect of monochromatic, coherent light on embryological development. The results show (1) Deformities can be the proJuct of either the ruby or gas laser. (2) The higher intensities produce more deformities. (3) The effect of laser radiation varies with the growth stage or physiological state of the egg exposed. (4) Pigmentation increases the susceptibility of the subject. (5) Other variables may alter the influence of the laser beam. The quantum energy of laser radiations is too low to cause ionization, excitation or direct bond dissociation but conversion to heat energy is believed to generate free radicals and denature proteins. Unpigmented tissues have low absorption coefficients but the high energy density of incident radiation can cause localized destruction. Pigmented tissue is effected by much lower energy densities. Author

N65-16625 Colorado State Univ., Fort Collins. Dept. of Physiology

RATE AND MAGNITUDE OF TENSION PRODUCTION OF VENTRICULAR MUSCLE FROM HIBERNATING AND NON-HIBERNATING MAMMALS

Frank E. South *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 251–258 refs (See N65-16601 07-04)

Contractility and irritability of trabecular strips of cardiac muscle obtained from rats, control hamsters and hibernating hamsters were studied at temperatures from 0° to 38° C. Tension production, and its first derivative with respect to time were studied simultaneously through the use of an RCA 5734 transducer tube and dc coupled amplifiers, oscilloscope and simple differentiating circuit. The effects of temperature on the latent periods of the muscles did not differ significantly. The effects upon excitability, tension and its maximal rate of production were such that at low temperature the rat tissues were most impaired followed by those of control hamsters. Those of hibernating (5° C) animals were the least affected. These variations in response were related to inherent and adaptive differences in the intensity and duration of the active state process. Author

N65-16626 Illinois Univ., Urbana. Dept. of Physiology and Biophysics

THE EFFECTS OF DECOMPRESSION ON FLATUS PRODUCTION CARBON DIOXIDE CONTENT IN MAN

F. R. Steggerda *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 259–262 refs (See N65-16610 07-04)

The subjects assumed a reclining position in a decompression chamber 3 hours after the last meal. A lubricated catheter containing a number of 1-cm holes for 7 cm back from the tip was inserted into the rectum for a distance of 15 cm. The open end of the catheter was then connected with a series of previously calibrated cylinders containing a solution of saturated sodium sulfate in 5% sulfuric acid. By clamping the proper tubing to the various cylinders, flatus could be collected for periods of time at designated altitudes. The volumes of flatus passed at various altitudes were recorded. The percentage carbon dioxide concentrations were determined after recompression had been produced at the end of the experiment. The partial pressure of the CO_2 was calculated on the basis of the altitude at which it was collected. Upon going to simulated altitudes of 35000 ft in the decompression chamber the collectable flatus volume progressively increases. Likewise the carbon dioxide increases in direct proportion to the volume charges. Author

N65-16627 Colorado Univ., Denver. Dept. of Radiology

KINETIC MODELS OF PHYSIOLOGIC SYSTEMS

Donald W. Brown *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 263–268 refs (See N65-16601 07-04)

Mathematical analysis of models of several physiologic systems is under study using both analog and digital computer techniques. Principal interest at this time is centered on the radioisotope renogram. A set of differential equations was derived which describes the known significant components of the renogram curve. Movement into and out of most of the compartments is handled as diffusion. Although the kidney and liver reactions are nonlinear, simplifications were made

that allow their evaluation by linear equations. A most important finding was the evaluation of a mathematical transfer function that operates on the integrated renal concentration of the isotopically labeled substance under consideration by the time it is discharged from the field of the probe. This transfer function correlates closely with the concept of a renal transit time as well as differential urine volume. A value also occurs in the equations which corresponds to the differential renal plasma flow. Knowledge of these two rate constants should be helpful in the evaluation of patients with hypertension. Author

N65-16628 Colorado Univ., Boulder. Chemical Engineering Dept.
ENGINEERING PROBLEMS IN THE LARGE-SCALE GROWTH OF MICROORGANISMS
R. E. West *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 269–273 refs (See N65-16601 07-04)

The large-scale growth of microorganisms creates some unique problems in process design, operation, and control. This paper describes some of these problems such as pure-culture requirements and genetic changes. Some kinetic aspects of fermentation reactions, especially mass-transfer phenomena, are also discussed. Studies of the effects of agitation on the rate of lactic acid formation by the bacterium *Lactobacillus delbrueckii* indicate that there is little bulk liquid-phase resistance to mass transfer in fermentation media. The slight effect of agitation on rate in the *L. delbrueckii* fermentation may be due to an influence on the rate of mass transfer of an essential nutrient. Author

N65-16629 Air Force Academy, Colo. Dept. of Chemistry and Physiology
CHANGES IN THE EKG OF THE RAT DURING ACCELERATION STRESS
Grover J. D. Schock *In its* Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 274–280 refs (See N65-16601 07-04)

Centrifugation at +20 G produces profound adverse conditions for the cardiovascular system. It is surprising that the rat can tolerate such force for periods in excess of 4 to 5 minutes. The EKG changes produced by such force follow a remarkably similar pattern. Immediately after onset of centrifugation a transient bradycardia develops. This is followed by tachycardia and a more or less regular respiration. These last until decompensation begins. This is signaled by a phenomenon similar to fibrillation. Immediately after fibrillation the heart rate falls rapidly to a rate of 120 per minute or less. If centrifugation is stopped at this time, about 50% of the animals recover. The gross changes in the EKG during centrifugation are probably due to hypoxia. Author

N65-16630 Tennessee Univ., Knoxville. Agricultural Research Lab.
LARGE ANIMAL ELECTRO ANESTHESIA
C. E. Short, C. C. Turbes, (Veteran Admin. Hosp., Houston, Tex.) and J. J. Snyder (Electron. Med. Instr. Co., Fort Collins, Colo.) *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 281–286 (See N65-16601 07-04)

Electroanesthesia was induced in seconds in sheep and cattle by 50 to 60 milliampere with one of the needle electrodes attached to the suture of the frontal bone at eye level, and the other to the occipital area of the head. During anesthesia all operations were successfully performed and the recovery was uneventful. Electro spinal anesthesia on a variety of large animals was effective. Nearly all animals were able to walk immediately after the operation upon removal of the current. It was found that experimental subjects tolerate a much higher level of current when they are in a sleep-like state. G.G.

N65-16641*# National Aeronautics and Space Administration, Washington, D. C.
THE USE OF AN INERT GAS IN AN ARTIFICIAL ENVIRONMENT [DE L'UTILITE D'UN GAZ INERTE DANS UNE ATMOSPHERE ARTIFICIELLE]
V. Strumza Feb. 1965 12 p refs Transl. into ENGLISH from The Man and Technol. in the Nucl. and Space Age, Proc. of the Intern. Congr., Milan, 18–21 Apr. 1962 Rome, Assoc. Intern Uomo Nello Spazio, 1963 p 487–492
(NASA-TT-F-9258) OTS: HC $1.00/MF $0.50

The type of atmosphere necessary to sustain man in space flight is considered. It is shown that a homogeneous atmosphere of pure oxygen at a pressure between 380 and 160 mm Hg has the advantage of simplicity. However, for an interplanetary voyage or for an observation satellite rotating around the earth for a long period of time, such an atmosphere would cause pulmonary disturbances, but the injection of a quantity of an inert gas into the oxygen atmosphere would prevent this condition. Helium is found to be preferable to nitrogen for the purpose. A technique is described for regenerating oxygen. Author

N65-16653# Library of Congress, Washington, D.C. Aerospace Technology Div.
SOVIET BIOASTRONAUTICS AND BIOTECHNOLOGY, 1964: COMPILATION OF ABSTRACTS Surveys of Soviet-Bloc Scientific and Technical Literature
11 Feb. 1965 122 p
(ATD-P-65-4)

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N65-16668# Sandia Corp., Albuquerque, N. Mex. Environmental Health Dept.
INDUSTRIAL HYGIENE HANDBOOK
R. J. Everett, L. W. Brewer, G. W. Edwards, A. Juskiewicz, T. A. Linn, Jr. et al Feb. 1965 149 p refs
(SC-RR-64-562) OTS: $5.00

Occupational health hazards may be classified as chemical and physical. This handbook covers procedures, devices, and equipment for controlling possible occupational hazards. Author

N65-16726# Joint Publications Research Service, Washington, D. C.
CURRENT PROBLEMS OF ELECTROPHYSIOLOGICAL INVESTIGATIONS OF THE NERVOUS SYSTEM
9 Feb. 1965 116 p refs Transl. into ENGLISH from the book "Sovremennyye Problemy Electrofiziologicheskikh Issledovaniy Nervnoy Sistemy" Moscow, Acad. of Med. Sci. USSR, 1964 p 115–131, 255–288, 393–401, 508–518
(JPRS-28687; TT-65-30303) OTS: $4.00

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3. ELECTROMYOGRAPHY Yu. S. Yusevich p 80–93 refs (See N65-16729 07-04)

4. METHODS OF MEASUREMENT AND ANALYSIS OF BIOELECTRIC POTENTIALS V. A. Kozhevnikov p 94–111 refs (See N65-16730 07-05)

N65-16727 Joint Publications Research Service, Washington, D. C.

ELECTROPHYSIOLOGY OF THE SPINAL CORD

P. G. Kostyuk *In its* Current Probl. of Electrophysiol. Invest. of the Nervous System 9 Feb. 1965 p 1–28 refs (See N65-16726 07-04) OTS: $4.00

Various techniques employed in electrophysiological recording of reflex activity are described. Although these were helpful in reaching conclusions, a more effective approach was in direct derivation and analysis of the cerebrospinal electrical activity. Several pathways are available along which the electrical potentials of the cell elements located inside the spinal cord can be derived. A few characteristic patterns obtained by intracellular derivation are presented. Sufficient data are now available which disclose a detailed picture of the functional organization of the spinal cord. Principles of the organization are discussed. E.E.B.

N65-16728 Joint Publications Research Service, Washington, D. C.

CURRENT THEORIES OF THE ORIGIN OF CORTICAL RHYTHMICITY AND ANALYSIS OF THE ELECTROENCEPHALOGRAM

L. A. Novikova *In its* Current Probl. of Electrophysiol. Invest. of the Nervous System 9 Feb. 1965 p 29–79 refs (See N65-16726 07-04) OTS: $4.00

The nature of the slow oscillations recorded during overall derivation of electrical brain potentials; theories of the origin of the continuous rhythmic activity of the brain, and the connection between cortical rhythm and the afferent flow of impulses, are discussed. Investigations of the human EEG, as well as the animal, lead to the conclusion that the flow of afferent impulses is of enormous importance to the formation of the cortical rhythm. A lengthy analysis and discussion of EEG interpretation is given. There are two diagonally opposed points of view concerning the nature of changes appearing on the EEG during afferent stimulation, usually termed arousal response. Facts and considerations of both views are presented. E.E.B.

N65-16729 Joint Publications Research Service, Washington, D. C.

ELECTROMYOGRAPHY

Yu. S. Yusevich *In its* Current Probl. of Electrophysiol. Invest. of the Nervous System 9 Feb. 1965 p 80–93 refs (See N65-16726 07-04) OTS: $4.00

Nature, objectives, methods, and techniques employed in clinical electromyographic examinations are discussed. Two basic points are emphasized in the discussion on the nature and objectives of EEG. First, a close relationship exists between the oscillations of potentials and the functional state of both the muscle and the nuclear segmental motor neurons innervating it. Second, while an electromyogram reflects directly the electrical excitation index for a large number of motor neurons and muscle fibers, it also indirectly characterizes the changes in the afferent impulses which condition the activity of the neuromotor mechanisms. E.E.B.

N65-16752# Instituto de Neurologia, Montevideo (Uruguay).

ATTENTION, HABITUATION AND CONDITIONING AS RELATED TO THE BRAIN WAVES Final Technical Report, May 1, 1960–Apr. 30, 1964

Elio Garcia-Austt, Jaime Bogacz, Adela Vanzulli, and Pablo Handler May 1964 17 p refs

(Grant AF-AFOSR-312-63)

(AFOSR-64-1841; AD-607374)

To study the mechanisms of sensory control, two investigations were conducted: (1) the visual and auditory evoked responses and changes on EEG background activity in man, and (2) the neural control of the cochlear input in the guinea pig. In the study of visual evoked responses (VER), the patterns of this potential were measured during wakefulness and sleep, during habituation to continuous and monotonous flicker stimulation, during photic habituation, and during interference of an attention-demanding task with extraneous stimuli. In all cases, a correlation was established between VER changes and subjective experience, and it was shown there was a close relationship between these changes and variation in attention. The effects of habituation, distraction, and sensory conditioning on auditory evoked responses (AER) were also studied. The sequence of changes in EEG background activity of a subject placed in a dark and quiet environment and then submitted to continuous flicker stimulation is reported. It was found that, although changes occurred simultaneously in VER and in background activity during habituation, VER was far more sensitive. D.S.G.

N65-16812*# Maryland Univ., College Park.

A STUDY OF PHYCOPHYSIOLOGY IN CONTROLLED ENVIRONMENTS Seventh Semiannual Status Report, 1 Apr.–1 Oct. 1963

Robert W. Krauss 1 Oct. 1963 43 p refs

(Grant NsG-70-60)

(NASA-CR-55554) OTS: HC $2.00/MF $0.50

CONTENTS:

1. ON THE VARIABILITY IN THE ACTIVITY OF THE PHOTOSYNTHETIC MECHANISMS C. Sorokin 10 p refs (See N65-16813 07-04)

2. BUFFERING ACTIVITY OF ALGAL CELLS AND ITS EFFECT ON CELL DIVISION [1, 2] C. Sorokin 20 p refs (See N65-16814 07-04)

N65-16813* Maryland Univ., College Park.

ON THE VARIABILITY IN THE ACTIVITY OF THE PHOTOSYNTHETIC MECHANISMS

Constantine Sorokin *In its* A Study of Phycophysiol. in Contolled Environ. 1 Oct. 1963 10 p refs Presented at the Symp. on Photosyn. Mech. of Green Plants, Warrenton, Va., 14–18 Oct. 1963 (See N65-16812 07-04) OTS: HC $2.00/MF $0.50

The variability in the activity of the photosynthetic mechanisms is investigated. Results are: (1) Studies on chlorophyll turnover in higher plants indicate that chlorophyll undergoes degradation in older tissues. (2) Observations on synchronized algal suspensions demonstrate that photosynthetic activity in older cells is inferior to that of cells of intermediate age even at intensities below light saturation where the rate of photosynthesis is assumed to be dependent on photochemical reactions. (3) Fluorescence intensity for older cells is

shown to exceed that of younger cells. With the inverse ratio existing between fluorescence yield and photosynthetic activity, observations on the increase in fluorescence with the age of the cells provide the most direct proof of changes in the distribution of energy in the photochemical act, i.e., changes bound with cell development. Thus, a cell never stands still; it is in constant flux. An interplay of biological factors may explain the inconsistency of observations on the photosynthetic activity of cells. I.v.L.

N65-16814* Maryland Univ., College Park.
BUFFERING ACTIVITY OF ALGAL CELLS AND ITS EFFECT ON CELL DIVISION[1, 2]
Constantine Sorokin *In its* A Study of Phycophysiol. in Controlled Environ. 1 Oct. 1963 20 p refs (See N65-16812 07-04) OTS: HC $2.00/MF $0.50

Buffering capacity of cells was evaluated in terms of its effects on changes in pH of the suspending fluid and on cell division. Synchronized 7-hour cells of the green, high-temperature alga, *Chlorella* 7-11-05, were centrifuged out of a complete nutrient medium, resuspended in different concentrations of sulfuric acid, and supplied in darkness with atmospheric air. It was observed that the effect of buffering activity of cells on pH of the surrounding medium was a gradual, time-dependent phenomenon. Changes in pH and the degree of the completion of cell division depended on the initial acidity of the medium and on the amount of cells per volume of suspension. With the increase in acidity, the amount of cells required to buffer it increased disproportionately faster. Thus, within a certain range of acid concentrations, a doubling in acidity required a 2.2-times increase in the amount of cells necessary to buffer the new level of acidity. Factors affecting buffering activity of cells were discussed. Author

N65-16815*# Hazleton Labs., Falls Church, Va.
RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE Quarterly Progress Report No. 15
Gilbert V. Levin and Norman H. Horowitz Dec. 1964 43 p refs
(Contract NASr-10)
(NASA-CR-60709) OTS: HC $2.00/MF $0.50

Photosynthetic activity of pure cultures of algae by radiological detection methods is reported. Retention and evolution of $C^{14}O_2$ is given for green, blue-green, and red algae, and marine diatom. Two algae were tested for photosynthetic response in buffered systems since results of previous experiments indicated that pH of the test media affected $C^{14}O_2$ exchange. For both organisms, pH had no effect on net $C^{14}O_2$ fixation by live cells. Retention by killed cells in acidified aqueous solution was confirmed. There was no difference in $C^{14}O_2$ evolved in acid or neutral media but there was strikingly greater evolution of $C^{14}O_2$ in alkaline media. The nonmetabolic absorption of $C^{14}O_2$ during the light phase and evolution from controls during darkness at alkaline pH's was as high as metabolic exchange of $C^{14}O_2$, amounting to a complex masking of metabolic activity. The addition of 5% dimethyl sulfoxide did not appear to enhance the inhibitory effect of Bard Parker on *Saccharomyces cerevisiae*. Seven new test soils and five soil isolates produced positive responses from basal C^{14} media. A 50% final concentration of unlabeled L-glucose in a labeled inorganic salt medium did not inhibit the growth of *Escherichia coli*. E.E.B.

N65-16826*# George Washington Univ., Washington, D.C.
SPACE BIOLOGY AND SPACE BIOSCIENCE RESOURCES BSCP Communique
Charles W. Shilling and Joe W. Tyson 15 Feb. 1964 311 p refs
(Grant NsG-485)
(NASA-CR-53419) OTS: HC $7.00/MF $1.75

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1. LIFE SCIENTISTS ASSOCIATED WITH RESEARCH PERTINENT TO SPACE BIOLOGY p 2-197
2. ROTATED DESCRIPTORS OF SPACE BIOLOGY, FOLLOWED BY INDIVIDUAL'S NAME p 198-272
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4. PARAMETERS OF SPACE BIOLOGY p 289-295
5. SPACE BIOLOGY IN THE U.S.S.R. p 296-308

N65-16880# Northrop Space Labs., Hawthorne, Calif.
GROWTH AND CULTURE CHARACTERISTICS OF CERTAIN MARINE ALGAL FLAGELLATES FOR MASS CULTURE
Richard W. Eppley, Denzel L. Dyer, and Frank M. Maciasr Brooks AFB, Tex., School of Aerospace Med., Oct. 1964 11 p refs
(Contract AF 41(609)-1608)
(SAM-TDR-64-63; AD-455416)

To determine the usefulness of marine algae in biologic regeneration of oxygen and food for space crews, *Dunaliella tertiolecta*, *D. primolecta*, and *Chlorella pyrenoidosa* TX71105 were grown in a continuous culture apparatus. The marine algae gave 50% to 70% the yield, in dry weight per day, obtained from *Chlorella*. In one case, *D. tertiolecta* attained 93% of the yield of *Chlorella*. The crude fiber content of *D. tertiolecta*, 0.6%, is only 20% to 25% of that for *Chlorella*. The first-order rate constant for sonic disruption of cells is a linear function of crude fiber content. While these marine forms are not likely to show oxygen production rates competitive with *Chlorella*, the relative fragility may indicate better nutritive value and perhaps greater usefulness for closed systems. Author

N65-16932*# Bio-Dynamics, Inc., Cambridge, Mass.
STUDY OF THE TRANSFERRAL OF SPACE TECHNOLOGY TO BIOMEDICINE Final Report
21 Feb. 1964 208 p refs
(Contract NASw-570)
(NASA-CR-60635) OTS: HC $6.00/MF $1.25

Examples of interdisciplinary innovation transfer, results of interviews and questionnaires, and a literature review were used to develop a series of recommendations for improving the transfer of space technology innovations into the life sciences. Several specific instances of transfer were documented, but the general impact of aerospace stimulation of entire fields of endeavor appears to be a more significant effect. NASA procedures for disseminating information were compared to those of several other agencies, and the implications of the differences are discussed. It is concluded that there is evidence of a spin-off of space technology into biomedicine, that the rate of transfer can be improved, and that active efforts to produce transfer are justifiable. Author

N65-16979*# General Mills, Inc., Minneapolis, Minn. Electronics Div.
RESEARCH TO DETERMINE THE EXISTENCE AND IDENTITY OF VIABLE MICROORGANISMS IN THE STRATOSPHERE Quarterly Status Report No. 2, 19 Jun.-18 Sep. 1963
V. W. Greene 8 Oct. 1963 7 p
(Contract NASw-648)
(NASA-CR-52518) OTS: HC $1.00/MF $0.50

Activities in the investigation of viable microorganisms in the stratosphere, and the status of the evaluation of data obtained from two high-altitude balloon flights are discussed. Work on simulation experiments to aid interpretation of stratospheric data is also reported. P.V.E.

N65-16983*# Florida State Univ., Tallahassee. Inst. for Space Biosciences

ELECTRON MICROGRAPHS OF MICROSPHERES FROM THERMAL PROTEINOID

Sidney W. Fox and Takeshi Fukushima [1963] 15 p refs
(Grant NsG-173-62)
(NASA-CR-52474) OTS: HC $1.00/MF $0.50

Production of microspheres from thermal proteinoid is discussed. These microspheres will be used as experimentally stable models in the development of an adequate theory of cellular origins. Properties which have been found and studied in the proteinoid microspheres include: (1) uniformity of size, (2) abundance, (3) responses of swelling and shrinking to salt solutions of appropriate concentration, (4) segmentability under pressure, (5) phycological modes of association, (6) birefringence, and (7) a photographed tendency to undergo septate division with change in pH. The polyamino acid material used for these studies was a 2:2:1 proteinoid prepared by the thermal copolymerization of the eighteen amino acids common to protein. A number of electron micrographs of microspheres treated in various ways are presented. P.V.E.

N65-16984*# Stanford Research Inst., Menlo Park, Calif.

STUDIES ON THE HILL REACTION ACTIVITY OF SOLUBLE CHLOROPLAST EXTRACTS Quarterly Progress Report No. 2, 1 Jun.–31 Aug. 1963

Bruce Graham 25 Sep. 1963 6 p
(Contract NASr-49(11))
(NASA-CR-52090) OTS: HC $1.00/MF $0.50

Progress is reported in the following areas: (1) methods of preparation and the storage stability of chloroplasts and chloroplast fragments; (2) the use of digitonin in the preparation of active chloroplast fragments and fractions; and (3) attempts to improve Hill reaction activity of digitonin preparations by Sephadex chromatography and by dialysis. I.v.L.

N65-17025# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM NAUCHNYYE DOKLADY VYSSHEY SHKOLY, BIOLOGICHESKIYE NAUKI (SCIENTIFIC REPORTS OF THE HIGHER SCHOOLS, BIOLOGICAL SCIENCES), NO. 3, 1964

16 Feb. 1965 51 p refs Transl. into ENGLISH from Nauchn. Dokl. Vysshei Shkoly, Biol. Nauki, (Moscow), No. 3, 1964 p 26–29
(JPRS-28782; TT-65-30345) OTS: $3.00

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1. THE CONFINES OF CHINESE ORNITHOFAUNAL COMPLEX IN THE BUREYE RIVER BASIN A. B. Kistyakovskiy and L. A. Smogorzhevskiy p 1–6

2. STIMULATION OF THE REGENERATIVE PROCESS OF AN EXTREMITY OF MAMMALIANS IN RESPONSE TO ACTION OF A TISSUE EXTRACT V. P. Kudokotsev p 7–13 refs

3. EFFECT OF BEE AND COBRA VENOMS ON THE NEUROMUSCULAR APPARATUS OF THE CAT N. M. Artemov, Yu. V. Goryachev, O. N. Lebedev, and A. S. Stepanov p 14–23 refs

4. GUSTATORY ANALYSIS IN CATS FOLLOWING EXTIRPATION OF THE SIGMOID GYRI A. S. Batuyev and L. A. Samoylova p 24–28 refs

5. CHANGES IN PHYSICO-CHEMICAL PROPERTIES OF ERYTHROCYTES DURING HEATING Yu. A. Kriger, Ye. A. Sverdlova, and A. A. Vaynson p 29–35 refs

6. RESISTANCE OF TRITON LENS TO RADIATION AND TRAUMA V. V. Popov and V. A. Golichenkov p 36–41 refs

7. INVESTIGATION OF ELECTRICAL CONDUCTIVITY OF SPLEEN TISSUE OF IRRADIATED ANIMALS Ye. V. Burlakova and M. L. Kakushkina p 42–48 refs

N65-17039# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.

MECHANICAL STIFFNESS OF MAN'S LOWER LIMBS

Arthur E. Hirsch and Leonard A. White Oct. 1964 21 p refs
(DTMB-1810; AD-608762)

Measurements of the compressibility or mechanical stiffness of the lower limbs under static loads are reported. Deformations of the various portions of the limb structure are discussed, and major load-bearing regions of the foot are identified. Author

N65-17052*# Walter Reed Army Inst. of Research, Washington, D. C.

TIMING BEHAVIOR AND STIMULUS GENERALIZATION

J. V. Brady and Bernard Migler [1963] 5 p
(Grant NsG-189-61)
(NASA-CR-53693) OTS: HC $1.00/MF $0.50

During stimulus generalization testing after discrimination training, gradual rate of decrements extending from S^D to S^Δ are commonly observed. The behavior over this range is assumed, therefore, to have decreasing "strength" across the stimuli. An alternate explanation is that the behavior that occurs during stimulus generalization testing occurs at full strength, but only occasionally, its frequency being determined by the proximity of the test stimulus to the training stimulus. Using a single lever technique it is difficult to obtain appropriate measures to examine this possibility. The question has been examined in the present experiment by using a two-response procedure. If reinforcement is contingent upon a proper time delay from response A to response B, one can then examine these time delays as well as the overall rate at which they occur during stimulus generalization. Author

N65-17053*# Washington Univ., Seattle. Coll. of Fisheries

***DAPHNIA* SURVIVAL STUDIES Progress Report No. 1, Nov. 1, 1963–May 1, 1964**

Frieda B. Taub [1964] 19 p refs
(Grant NsG-519)
(NASA-CR-56112) OTS: HC $1.00/MF $0.50

Experiments were performed to define the most suitable conditions for a 7-day flight of *Daphnia*. The best culture medium developed is *Chlamydomonas reinhardti* culture diluted with aquarium water to 2.5×10^6 cells/ml plus calcium pantothenate (300 mg/l). The survival of 75% of the original animals and the birth of approximately 24 young per female can be expected if other factors do not become limiting. The flight chambers were designed on a modular basis. Each module contains two chambers each for four pregnant *Daphnia*, plus their algal food, one chamber for algae only, and necessary preservation equipment. Morphological studies were concerned with (1) normal morphology and embryology, (2) the feasibility of the use of exoskeleton markings as an index of cellular change, and (3) the induction of cyclomorphosis. Pictures of normal morphology, embryology, and exoskeleton structure are shown. A collection of 10 species were maintained to provide alternate species with a variety of environmental requirements. Author

N65-17054*# State Univ. of New York at Buffalo. School of Medicine

PRIMITIVE EARTH SYNTHESIS OF AMINO ACIDS AND POLYPEPTIDES Status Report, Jul. 1–Dec. 31, 1963

Charles U. Lowe 30 Jan. 1964 3 p

(Grant NsG-476)

(NASA-CR-53134) OTS: HC $1.00/MF $0.50

Studies were conducted to determine the contribution of a heavy metal contaminant in ammonium cyanide to the formation of amino acids and amino acid conglomerates under the influence of heat. Reaction products resulting from interaction of gaseous HCN with aqueous ammonia and of liquid HCN with aqueous ammonia were compared. Results indicated that the reactions progress to largely similar conclusions. The results of efforts to isolate polymers formed in the above process by combining continuous-flow electrophoresis and paper-strip chromatography are summarized in an abstract of a paper entitled *Incorporation of Glutamic Acid into Amino Acid Complexes in Aqueous NH_4CN.* D.S.G.

N65-17055*# Nevada Univ., Reno.

EXPERIMENTS ON THE EFFECTS OF LOW PRESSURES ON CELLULAR ULTRASTRUCTURE AND CYTOCHEMISTRY IN PLANTS Semiannual Progress Report, Apr. 1–Sep. 30, 1963

Hugh N. Mozingo [1963] 11 p refs

(Contract NsG-464)

(NASA-CR-55179) OTS: HC $1.00/MF $0.50

The effects of reduced pressure on the germination and distal displacement of the new cell plate in epidermal root tip division of timothy (*Phleum pratense*) and on the growth rate and photosynthetic rate of *Elodea* were investigated. A significant percentage of the timothy population retained its capacity to grow at reduced pressures, and *Elodea* exhibited feeble growth after 8 months at nearly complete vacuum. Light microscope studies revealed no significant change in the degree of distal displacement as a result of exposure to low pressures. Electron microscope studies revealed no major gross changes in the cellular structure of those timothy seedling roots which did grow under reduced pressure, although some changes in the numbers, distribution, and appearance of cellular organelles were noted. A new plastic embedding technique is reported which reduces handling of the specimen. M.P.G.

N65-17056*# Ohio State Univ. Research Foundation, Columbus.

BIOLOGICAL EFFECTS OF PROLONGED EXPOSURE OF SMALL MAMMALS TO CLOSED GASEOUS ENVIRONMENT Semiannual Report, 28 Feb.–31 Aug. 1963

E. P. Hiatt 22 Aug. 1963 9 p refs *Its* Rept.-2

(Grant NsG-295-62; RF Proj. 1492)

(NASA-CR-51657) OTS: HC $1.00/MF $0.50

Experimental work was conducted to determine the effects of prolonged exposure of small mammals to closed gaseous environments. Chicken embryos were used to screen a number of gaseous environments for deleterious effects and to obtain leads which can be validated through experimentation with mammals. Experimentation included a study of the effect of almost nitrogen-free environments; oxygen toxicity; the blood flow to bone marrow and other organs following varying periods of intermittent hypoxia in the rat; and the gas exchange and cardiovascular effects in short periods of intensive isometric exercise in man. C.L.W.

N65-17057*# Ohio State Univ. Research Foundation, Columbus.

BIOLOGICAL EFFECTS OF PROLONGED EXPOSURE OF SMALL ANIMALS TO UNUSUAL GAS ENVIRONMENTS Third Semiannual Progress Report, 1 Sep. 1963–29 Feb. 1964

E. P. Hiatt 1 Mar. 1964 9 p refs

(Grant NsG-295-62)

(NASA-CR-53543) OTS: HC $1.00/MF $0.50

Biological effects of (1) exposure of mice to pure oxygen at one atmosphere with varying daily periods of air breathing; (2) the influence of prolonged exposure of chickens to almost pure oxygen; and (3) tissue metabolism of chicken embryos incubated in an atmosphere of 79% helium plus 21% oxygen are reported. Mice survived exposure of oxygen better when they had a daily period of air breathing as short as two hours, and the benefit increased with the time of air exposure per day up to at least eight hours. The lungs of mice showed pathological changes when the mice were exposed to oxygen for periods of at least eight hours per day. Severity of damage increased with daily time of exposure to oxygen but reversed on exposure to air. Animals which survived a 20-day exposure of oxygen, with periods of air breathing, were not more vulnerable to effects of further exposure to oxygen than were unexposed mice. E.E.B.

N65-17058*# St. Louis Univ., Mo.

PHYSIOLOGICAL EFFECTS OF WEIGHTLESSNESS AND SPACE RADIATION ON HIBERNATORS Second Semiannual Status Report

X. J. Musacchia Jun. 1963 5 p

(Grant NsG-271-62)

(NASA-CR-50546) OTS: HC $1.00/MF $0.50

Irradiation of ground squirrels and hampsters with cobalt-60 facility is reported. The facility is described in detail. Also reported are the autoradiographic and other cytochemical techniques employed in regeneration of intestinal epithelium. The following observations were made: (1) Mitotic activity is localized in the basal layer of cells in the turtle intestinal epithelium. (2) Mitosis duration is estimated at 2 hours in the turtles maintained at 20° to 24° C. (3) Complete renewal of cell population of the intestinal epithelium takes about 8 weeks. (4) Mitotic activity in cold torpid turtles is suppressed and its reactivation upon warming the animals is retarded. Also, hibernating ground squirrels subjected to 2000 R of x-irradiation demonstrated decreased concentrations of catecholamines. E.E.B.

N65-17067*# Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology

THE USE OF PATHOGEN-FREE PLANTS IN A MICROCOSM. THE EFFECTS OF HIGH INTENSITY LIGHT ON PLANT GROWTH

Ralph Baker 12 Dec. 1962 4 p

(Grant NsG-78-60)

(NASA-CR-50170) OTS: HC $1.00/MF $0.50

Results of investigations on the use of pathogen-free plants in a microcosm indicate that: (1) Plants grow more slowly in a germ-free environment. (2) Competition in a three-membered system exists. The system consists of a host (bean plant), a pathogen (*Fusarium solani* f. *phaseoli*), and an active competitive saprophyte (*Fusarium roseum*). The presence of the competitive saprophyte decreased the pathogenicity of the pathogen on the host. Pathogenicity was further reduced by manipulation of the soil environment

so that nitrogen became limited. This is an example of the possibility of biological buffering of a soil to decrease the effects of harmful organisms and is believed to be the first demonstration of this phenomenon in a rigorous gnotobiotic system. Also presented are results of investigations on the influence of light intensity, air temperature, wind velocity, radiation environment, and light quality on plant temperature, as well as a discussion of the energy transfer mechanisms which control the exchange of energy between the plant and its surroundings. I.v.L.

N65-17068*# Lockheed-California Co., Burbank. Biophysics Research Div.
INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE CENTRAL NERVOUS SYSTEM IN VIVO AND IN VITRO First Quarterly Progress Report, Jul. 16–Oct. 18, 1963
J. Ralph Meigs [1963] 5 p
(Contract NASw-787)
(NASA-CR-52231) OTS: HC $1.00/MF $0.50

An investigation of the effects of ionizing radiation on the central nervous system *in vivo* and *in vitro* was conducted. Included are both technological progress and experimental progress in studying the effects of ionizing radiation on the central nervous systems of X-irradiated rats and cats, and in studying the electrical characteristics associated with neurophysiological processes of neurons and neuroglia in tissue culture, and the subsequent effects of ionizing radiation. C.L.W.

N65-17070*# Martin Co., Baltimore, Md. RIAS Div.
RESEARCH IN PHOTOSYNTHESIS Quarterly Report No. 3, 6 Dec. 1963–6 Mar. 1964
Bessel Kok [1964] 6 p
(Contract NASw-747)
(NASA-CR-53601) OTS: HC $1.00/MF $0.50

Research progress in chloroplast lipids, photoinhibition, photosynthetic electron transport, oxygen exchanges in chloroplast reactions, and photopotentiation of ATP hydrolysis are reported in relation to the study of photosynthesis. Results of the work on photoinhibition led to the conclusion that of the two photoreactions of photosynthesis, the one which evolves oxygen is the one most sensitive to inhibition by light. E.E.B.

N65-17071*# Connecticut Agricultural Experiment Station, New Haven.
PLANT LEAVES FOR THE PRODUCTION OF OXYGEN IN A CLOSED SYSTEM Fourth Quarterly Status Report
Dale N. Moss 20 May 1963 14 p
(Contract NASr-129)
(NASA-CR-50295) OTS: HC $1.00/MF $0.50

It has been found that the 1 ft^3 of oxygen per hr^{-1} required by man could be produced by 75 ft^2 of maize, sugarcane, or sunflower leaves, under ideal conditions. However, the weight and volume of the closed ecological systems containing the plants, plant chamber, accessory equipment must be reduced to render them feasible for the production of oxygen in space. To reduce the weight of such systems, vermiculite is used as a rooting medium, the water used by the system is reduced by recirculation, the number of lamps is reduced by installing a chromium reflector, and lightweight materials are used for the enclosure and accessory equipment. To reduce the systems' volume, many leaves are packed in a small space, illumination is increased, CO_2 concentrations are increased, and the temperature is optimized. Numerous plants have been screened for use in a closed ecological system. However, it has been found that sugarcane is possibly the most likely candidate for the final system since it has the lightest O_2 production per unit leaf of any plant tested, can be grown as a perennial, and can be quickly started from the root system; the optimum conditions for O_2 production are a temperature of 30° C, 0.1% CO_2, and intense light. A closed system that may support two men is discussed as well as the testing of production rates of cane in this system. D.E.R.

N65-17072*# Connecticut Agricultural Experiment Station, New Haven.
PLANT LEAVES FOR THE PRODUCTION OF OXYGEN IN A CLOSED SYSTEM Final Report
Dale N. Moss 22 Nov. 1963 3 p
(Contract NASr-129)
(NASA-CR-55131) OTS: HC $1.00/MF $0.50

Sugar cane was chosen as the plant for use in a closed ecological system. A closed system was designed to support two men. A single test was completed with this system, using sugar cane as the test plant. In that test, the two foot square area produced only one-tenth of the O_2 required to support man. The major difficulty was found to be chlorophyll bleaching in leaves nearest the lights. Thus, these leaves were not producing O_2 and, in turn, shaded other leaves cutting their production rate. However, of great promise was the fact that an extremely large area of leaves (estimated at 400 ft^2) was maintained in the chamber for three months. Thus, if only half the maximum rate of photosynthesis could be maintained, the chamber could support two men. I.v.L.

N65-17083# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PHYSIOLOGICAL SHIFTS IN THE HUMAN ORGANISM DURING ACCLIMATIZATION IN THE INTRACONTINENTAL REGIONS OF ANTARCTICA
I. I. Tikhomirov 2 Dec. 1964 16 p refs Transl. into ENGLISH from Vestn. Akad. Med. Nauk SSSR (Moscow), v. 3, no. 17, 1962 p 74–82
(FTD-TT-64-286/1+2; AD-609790)

Numerous observations were made of many physiological variables in explorers enroute to an inland station in Antarctica and during their year-long stay there. Initial symptoms of mountain sickness are reported, a 6-month period of decreasing general tone of the organism is discussed, and a subsequent 5-month period of further acclimatization is described. Parameters measured included arterial pressure, pulse frequency, systolic pressure, respiratory frequency and volume, atmospheric pressure, oxygen and CO_2 content of the air, blood oxygenation level, body temperature, blood analysis, and leukocyte content of the blood. It is concluded that, during the course of a year's stay, significant changes, mostly adaptive, occurred in the bodies of the men; that the limits of human adaptation to environmental changes are quite narrow; and that future work should be devoted to improving the environment rather than the adaptation. D.E.W.

N65-17139# RAND Development Corp., Cleveland, Ohio.
THE USE OF LINES OF NONEXTENSION TO IMPROVE MOBILITY IN FULL-PRESSURE SUITS Technical Report, Mar. 1963–Mar. 1964
Arthur S. Iberall Wright-Patterson AFB, Ohio. AMRL, Nov. 1964 44 p refs
(Contract AF 33(657)-10992)
(AMRL-TR-118; AD-610519)

The program of investigation pursued was (1) to map out the lines of nonextension; (2) to test whether string elements of high elastic modulus, a connected network, could be laid along these lines of nonextension without providing any constraint to mobility; (3) to obtain a highly mobile pressure-retaining layer to be constrained by the net; and (4) to construct and demonstrate an entire pressure-retaining garment

system that makes use of all necessary layers and string elements in a completely connected, netted covering for the body, with minimal constraint to mobility up to 5 psi. The technique, result, and collateral observations relevant to each of these phases are described. A mobile, pressure-retaining garment was developed by building each structural, functional layer into the composite garment in accordance with the basic design theory. Author

N65-17194# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SENSORY REACTIONS OF MAN AND SENSITIVITY OF THE VESTIBULAR ANALYZER UNDER SHORT-TERM WEIGHTLESSNESS
Ye. M. Yuganov, I. A. Sidel'nikov et al 8 Dec. 1964 15 p refs Transl. into ENGLISH from Izv. Akad Nauk SSSR, Ser. Biol. (Moscow), no. 3, 1964 p 369–375
(FTD-TT-64-1052/1+2+4; AD-610348)

Vestibular stability was studied in 30 men. They were divided into three groups: (1) those who endure weightlessness without physical impairment and a lowering of the capacity for work; (2) those who experience illusory sensations of the position of the body in space under a condition of weightlessness, and (3) those who experience unfavorable reactions very quickly, resulting in symptoms of airsickness. It was concluded that (1) the character and degree of sensor reactions under short-term weightlessness depend on the dissimilar vestibular sensitivity of persons subjected to this effect, (2) a man's capacity to work in short-term weightlessness can be predicted by vestibular testing, and (3) the degree of the sensitivity and stability level of inhibiting effects of the vestibular analyzer are dependent upon the individual being tested, i.e., to the degree the individual experiences motion sickness in weightlessness. E.E.B.

N65-17230# Lafayette Clinic, Detroit, Mich. Psychophysiology Lab.
VALIDATION OF THE AEROSPACE MEDICAL RESEARCH LABORATORIES 3-CHANNEL PERSONAL TELEMETRY SYSTEM
Alfred F. Ax Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 31 p refs
(Contract AF 33(657)-9352)
(AMRL-TR-64-124; AD-610589)

The art of physiological telemetry is borderline in three areas: (1) sensors, (2) transmitter, (3) data processing. This study assessed the AMRL three-channel personal telemetry from all three aspects. Analysis of the records transmitted from men in various graded intensities of physical activity revealed that of the three physiological variables (respiration, EKG and temperature), respiration was the least valid. Torso circumference changes sensed by rubber tube strain gages proved superior to the impedance method for measuring respiration. Some tentative findings on a stress interview study reveal the telemetry method to have promise. It was shown that the major difficulty preventing widespread use of physiological telemetry in significant field situations is the lack of a practicable high-speed data processing system that can distinguish and utilize the occasionally valid physiological signal emersed in artifact or noise produced by movements and changing environmental influences. The solution to the artifact problem is to sense and utilize movement and environmental influences, to gate out, and to correct the physiological data; and to develop automatic editing apparatus and computer programs for recognition and selection of the valid signal patterns. Author

N65-17289*# Oak Ridge National Lab., Tenn. Biology Div.
THE ORNL SPACE BIOLOGY PROGRAM Annual Report, Period Ending Jun. 30, 1963
G. E. Stapleton and M. A. Bender 8 Nov. 1963 39 p
(NASA Order R-60; NASA Order R-77)
(NASA-CR-52679; ORNL-TM-720) OTS: HC $2.00/MF $0.50

The investigations are divided into two chief categories: (1) a basic supporting program, which includes the ground-based laboratory research chiefly concerned with the relative biological effectiveness (RBE) of high-energy protons on a variety of biological materials ranging from bacteria to human blood cells, and (2) a biosatellite program, which involves the development of testing methods and base-line radiation effects data on a number of biological materials for experiments in space vehicles in flight. To date, the necessary equipment and instrumentation have been developed for proton irradiations, and experiments have been done with 22-Mev and 130-Mev protons. The results of these experiments are reported here. The biological experiments flown in the BIOS I space probe and the 1962 Goose Bay high-altitude balloon flights, and the experience gained from participation in the flights, are discussed. Author

N65-17290*# Army Chemical Corps., Fort Detrick, Md. Physical Defense Div.
STERILIZATION OF NATURALLY CONTAMINATED METAL SURFACES WITH DRY HEAT Protection Branch Report of Test No. 8-64
Dorothy M. Portner 16 Oct. 1963 6 p refs
(NASA Order-35)
(NASA-CR-52899) OTS: HC $1.00/MF $0.50

Investigations into the dry heat sterilization of naturally contaminated metal surfaces were conducted. Results indicate: (1) Almost 1000 microorganisms were recovered from a stainless steel strip (approximately 500/in.^{2}) after exposure to air for 33 days. (2) None of these stainless steel strips exposed to 135° C for 12 hours or 24 hours contained any viable microorganisms as evidenced by the lack of microbial growth after 7 days' incubation in a fluid thioglycollate medium. After 7 days' incubation period, broth samples in which the strips had been placed all supported bacterial growth when about 100 spores of *Bacillus subtilis* var. *niger* were deliberately introduced. (3) The number and type of viable organisms on a surface, at any specific time, vary considerably. (4) Almost all of the microorganisms recovered were aerobes, with spore-forming bacteria the most predominant type. (5) Data support the choice of the time–temperature combination of 135° C for 24 hours for sterilizing a spacecraft provided that particular care is taken to keep the spacecraft clean during assembly. I.v.L.

N65-17303# Joint Publications Research Service, Washington, D. C.
GAS EXCHANGE THROUGH THE SKIN AND ITS IMPORTANCE FOR THE HUMAN BODY
N. M. Petrun' 26 Feb. 1965 66 p Transl. into ENGLISH from the book "Gazoobmen Cherez Kozhu i Yego Znacheniye Dlya Organizma Cheloveka" Moscow, Medgiz, 1960 p 2, 18–34, 99–133, 152–161
(JPRS-28923; TT-65-30402) OTS: $3.00

The question of gas exchange (oxygen, carbon dioxide and, in part, nitrogen) through the human skin, and its significance for the body under normal and pathological conditions, is explored. It is shown conclusively that gas exchange through the skin increases sharply in difficult situations (physical stress, overheating, etc.), acquiring

practical significance in making up for inadequacy of pulmonary gas exchange. It should be assumed that such a compensatory role of cutaneous gas exchange acquires still greater importance during illness of the body. Author

N65-17306# Mayo Clinic, Rochester, Minn.
PLEURAL PRESSURES IN DOGS IN SUPINE AND PRONE BODY POSITIONS STUDIED WITHOUT THORACOTOMY
W. J. Rutishauser, N. Banchero, A. G. Tsarkiris, R. E. Sturm, and E. H. Wood [1965] 14 p

Pleural pressures were measured with saline-filled catheters. This avoided air around the catheter tip and hence all air-fluid or air-balloon-fluid interfaces, and the associated complicating surface tension effects on the pressure transducer system. These studies indicated that intrapleural pressures recorded at the superior surface of the lungs are uniformly more negative than pressures recorded simultaneously from the dependent surface. These differences in pressure, when expressed as a mean gradient per centimeter of vertical distance separating the two lung surfaces, are greater when the animal is in the prone position than when in the supine position. E.E.B.

N65-17385# Harvard Univ., Cambridge, Mass. Lab. of Psychophysics
[HUMAN ENGINEERING AND SENSUAL PERCEPTIONS] Progress Report No. 42, 1 Jan.–30 Jun. 1964
S. S. Stevens et al 30 Jun. 1964 20 p refs
(Grants NSF G-10716; NIH B-2974)
(PPM-106; AD-602964)

Six descriptive abstracts are presented. The projects are concerned with theoretical and experimental investigation of psychophysical aspects of auditory perception, and analogous phenomena of other phases of sensory perception. E.P.V.

N65-17465*# National Aeronautics and Space Administration, Washington, D. C.
SPACE PHYSIOLOGY, SOME RESULTS AND PROSPECTS OF EXPERIMENTAL INVESTIGATIONS [KOSMICHESKAYA FIZIOLOGIYA, NEKOTORYYE ITOGI I PERSPEKTIVY EKSPERIMENTAL'NYKH ISSLEDOVANIYA]
O. G. Gazenko, V. V. Parin, V. N. Chernigovskiy, and V. I. Yazdovskiy Mar. 1965 19 p Transl. into ENGLISH from a paper presented at 10th Congr. of the I. P. Pavlov All-Union Physiol. Soc., Yerevan, USSR, 22–28 Oct. 1964
(NASA-TT-F-305) OTS: HC $1.00/MF $0.50

The results of telemetric investigations carried out during suborbital and orbital flights in space are described. Studies of animals during suborbital flights in 1957 to 1959 showed that excess gravity in dogs was associated with changes in the cardiovascular and respiratory systems. An active or passive defense reaction developed. Later, under conditions of weightlessness, these indices approximated prelaunch levels. Experiments in 1960–1961 which involved the study of various specimens, including animals, plants, microorganisms and biochemical substrates, during flight and after their return to earth confirmed the results of earlier tests. Stability of these physiological parameters developed after some time under conditions of weightlessness, although the cardiovascular and respiratory systems showed some retardation in centrifuge studies. There was some instability in the cardiac rhythm. Animals functioned with little energy and some disruption of physiological and biochemical parameters occurred. It was concluded, however, that space flight does not have any unfavorable biological effects on man or animals. Effects of long-term weightlessness and the environmental requirements of extended space flight were studied. Although there were some irregularities in heart action and some fatigue and irritation after the flight, no pathological indications were found. The last flight compared the reactions of the female and male organism. The results again indicated a gradual adaptation to the conditions of flight, although some symptoms of general fatigue were observed. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-16403 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF ENGINEERING PSYCHOLOGY IN COSMONAUTICS AND CERTAIN INVESTIGATIONAL RESULTS
V. G. Denisov, Ye. S. Zav'yalov, A. P. Kuz'minov, M. M. Sil'vestrov, and V. D. Yazdovskiy *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 207–233 refs (See N65-16391 07-30)

The article presents a definition of engineering psychology and its problems in the development of spacecraft control systems, and the training of cosmonauts [astronauts] in their professional activities. A complex method is proposed for the evaluation of the closed operator-vehicle system in which, in conjunction with the application of cybernetics and information theory to provide engineering estimates for the technical elements, extensive use is also made of physiological recording of the biopotentials of various human functional systems characterizing the level of tension and ability of the operator to function. Certain of the problems involved in the development of training facilities are touched upon. A system consisting of complex, specialized, and functional training facilities is recommended for the solution of problems relating to the training and maintenance of skills on the parts of the cosmonauts. The development of onboard training facilities is recommended for the maintenance of skills in prolonged space flights. Author

N65-16422# George Washington Univ., Washington, D.C. Human Resources Research Office
RADAR TARGET DETECTION AS INFLUENCED BY EXPERIENCE AND TRAINING
A. D. Wright, Edward W. Frederickson, and James L. Claflin 20 Oct. 1964 61 p refs Sponsored by Army
(AD-455767)

The performance of experienced and inexperienced radar observers in detecting targets on the plan position indicator display of radar systems was investigated. The performances of the following three groups of observers were compared: (1) experienced observers, (2) inexperienced observers given "show and tell" training, and (3) inexperienced observers without any training. Statistically reliable differences between the three groups were observed. A second test with a Nike Hercules system and the AN/MPQ-36 radar target and ECM simulator confirmed the findings of the first test. No reliable differences in detection occurred that were associated with the experience factor. G.G.

N65-16431*# Naval School of Aviation Medicine, Pensacola, Fla.
THE PROBLEM OF MAN'S GRAVITATIONAL-INERTIAL FORCE ENVIRONMENT IN SPACE FLIGHT Progress Report No. 2, 1 Jun.–30 Sep. 1963

Ashton Graybiel [1963] 2 p refs
(NASA Order R-93)
(NASA-CR-51786) OTS: HC $1.00/MF $0.50

By exposing normal persons and deaf subjects with bilateral vestibular defects to centripetal force on a human centrifuge while submerged to the neck in water, the contribution of the otolith organs to postural and visual upright was demonstrated. Comparative measurements obtained (utilizing C-131 and KC-135 aircraft modified for exposing subjects to zero g and subgravity states) on normal persons and labyrinthine defective subjects included ocular counter-rolling, perception of the upright, and susceptibility to canal sickness. P.V.E.

N65-16433*# Naval School of Aviation Medicine, Pensacola, Fla.
THE PROBLEM OF MAN'S GRAVITO-INERTIAL FORCE ENVIRONMENT IN SPACE FLIGHT Progress Report No. 4, 1 Jan.–31 Mar. 1964
Ashton Graybiel [1964] 4 p refs
(NASA Order R-93)
(NASA-CR-56358) OTS: HC $1.00/MF $0.50

Nystagmus habituation to both simple and complex vestibular stimulation is influenced by visual factors. The influence is specific to the direction of the reaction inhibited by vision. Evidence was obtained which supports the thesis that voluntary visual suppression of nystagmus by the subject is a subtle variable which partially controls nystagmus habituation. The decreasing functional response of the otolith organ as a function of decreasing levels of gravity-inertial force between the earth's gravity and weightlessness has been determined. Ten subjects with labyrinthine defects (L-D), one subject with a high threshold to thermal stimulation of the canals, and sixteen normal subjects were exposed to extremely heavy seas. Only one of the L-D subjects had symptoms suggesting seasickness. All of the normal subjects but one were sick. E.E.B.

N65-16513 Joint Publications Research Service, Washington, D. C.
PALEONTOLOGY AND BIONICS
G. S. Al'tov *In its* Transl. from Priroda (Nature), Vol. 53, No. 11, 1964 · 25 Jan. 1965 p 34–36 (See N65-16510 07-30) OTS: $2.00

The study of fossils of extinct animals is discussed in relation to the possible application of knowledge gained to the design of better implements for modern industry. A double drilling bit designed on the basis of the triple teeth of the dinosaur *Saurolophus* is discussed, and devices designed after a study of the medusa and two types of ichthyosaurus are mentioned. D.E.W.

N65-16517# RAND Corp., Santa Monica, Calif.
THE ECOLOGICAL COMPLEX IN EXTRATERRESTRIAL BASES
S. H. Dole Nov. 1964 8 p refs Presented at 3d Ann. Meeting of the Working Group on Extraterrestrial Resources, 18–20 Nov. 1964
(P-3009; AD-608840)

The concept of an earth-style ecological complex created within an extraterrestrial base is examined, and compared with other kinds of life support systems that might be used in such bases. Per capita quantities of ecological supplies on earth are considered as an upper extreme (not feasibly reproducible in an extraterrestrial base). The lower extreme is approximated by the quantities of materials present in a minimal per capita volume of air plus a 1-day reserve (based on average metabolic requirements), which is assumed to be 700 cubic feet/man/day consisting of 50-50 oxygen–nitrogen at 7.5 psia. Food production and storage, energy supplies, and air and water regeneration atmosphere requirements are considered to be separate quantities. Types of food plants and production methods are discussed. Physicochemical and algal regenerative life support systems are compared with hydroponics. E.P.V.

N65-16602 North American Aviation, Inc., Downey, Calif. Autonetics Div.
TRENDS AND DEVELOPMENTS IN BIONICS AND BIOENGINEERING
Victor W. Bolie *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 4–8 refs (See N65-16601 07-04)

Bioengineering is defined as the application of engineering principles to biology and medicine, and bionics involves the transfer of biological principles to engineering technology. Bionics research is aimed toward the automation of the higher level functions of the human brain, and covers interacting fields with bioengineering in the design of new recording instruments for body functions, systems analysis of interacting physiological functions, automation of routine medical tests, and computer diagnosis of diseases. G.G.

N65-16603 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
BIOENGINEERING CONTRIBUTIONS TO ACCELERATION STRESS RESEARCH AND SIMULATION
Randall M. Chambers (Pennsylvania Univ.) *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 9–25 refs (See N65-16601 07-04)

Using the human centrifuge and its associated instrumentation, techniques were developed for simulating the accelerations encountered in spacecraft during launch, reentry, and abort maneuvers. These simulations were found to be effective for the acceleration training of astronauts and test pilots, and for the testing of life support systems and associated cockpit instrumentation. Major bioengineering contributions were made in the development of techniques to measure the effects of acceleration on psychophysiological performance. Primary emphasis is given to the use of the human centrifuge and its associated instrumentation, which have been developed for scientific research. Author

N65-16610 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INSTRUMENTATION REQUIREMENTS FOR LIFE DETECTION SYSTEMS
Jerry L. Stuart *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 88–97 (See N65-16601 07-04)

The approaches taken in performing biological and chemical analyses on a planetary surface must differ from conventional techniques. Analytical and functional experiments should be performed in which both simple and highly specialized organic compounds are sought. Well-understood fundamental measuring techniques should be adapted and combined to give the instrumentation a wide versatile performance capability. Each class of instruments (e.g., wet chemistry, dry chemistry, morphological analyses, etc.) should be unified into an experimental instrument in order to economize the spacecraft systems constraints. A review of the sample collection problem is presented along with a brief discussion of several life detection instruments under development. Author

N65-16613 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PROBLEMS IN PERSONAL PROTECTION AND PERFORMANCE DURING EXTRAVEHICULAR OPERATIONS

William L. Lee, Jr. *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 123–140 refs (See N65-16601 07-04)

Currently programed manned space systems plan for the initiation and extension of extravehicular operations. Extravehicular operations offer potential advantages in a variety of space missions, but several rather formidable personal protective and performance problems must be overcome to assure that safe and effective extravehicular operations become a reality. The extravehicular crewmember must be provided with reliable protection from the completely hostile space environmental factors of high order vacuum, electromagnetic and corpuscular radiations, and micrometeoroids. However, the means of providing such protection must not interfere with man's performance capabilities to such a degree as to preclude the effective accomplishment of extravehicular tasks. These factors combine to form the greatest challenge that personal protective technology has ever been called upon to meet. A multidisciplined scientific effort in personal protective technology complemented by interaction with spacecraft designers will be required to provide this extension of space operational capabilities. Author

N65-16614 Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

INSTRUMENTATION IN BEHAVIORAL RESEARCH

Gregg A. Gilbert *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 141–145 (See N65-16601 07-04)

The design and development of a research operant conditioning apparatus for the evaluation of animal performance in space environments is described. The apparatus consists of (1) the performance panel which provides the stimuli to which the subject is trained to make an overt response, (2) the equipment to provide positive and negative reinforcement, (3) the electronic controls of the behavioral programing equipment, and (4) the recording equipment. G.G.

N65-16618 Air Force Academy, Colo.

THE STUTTERING PROBLEM CONSIDERED FROM AN AUTOMATIC CONTROL POINT OF VIEW

Blaine R. Butler *In its* Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 187–209 refs (See N65-16601 07-04)

This paper discusses a simple model of the human speech system, considered as a feedback control mechanism. The speech system and the model are both normally stable. Stuttering is considered to be an unstable situation and the ear, which is a variable gain device, was chosen as a possible cause of this instability. There are certain known corrections to stuttering that are presently in use in speech clinics throughout the country. These corrections were applied to the model and restored the stability of the system. This analysis was done mathematically as well as on the analog computer and the results were compatible. Author

N65-16657*# Honeywell, Inc., Boston, Mass. Honeywell Radiation Center

A SAMPLING THEORY FOR THE HUMAN VISUAL SENSE

John Merchant [1959] 45 p refs Prepared jointly with Allied Res. Associates, Concord, Mass. Submitted for Publication

(Contracts NASr-16; NASw-535)

(NASA-CR-60618) OTS: HC $2.00/MF $0.50

The nature of the sampling operation performed by the human visual sense, restricted to black and white, nonstereoscopic, photopic vision, is discussed. The hypothesis is presented that the human visual sense samples the power spectrum (in terms of spatial frequencies) of the input image, just as the aural sense samples the power spectrum of the input sound. Author

N65-16662# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

HEARING SENSATIONS IN AMPLITUDE MODULATED RADIO FREQUENCY FIELDS

William Tarver Harvey and James Page Hamilton (M.S. Thesis) Aug. 1964 55 p refs

(GE/EE/64-11; AD-608889)

When the head is subjected to an amplitude modulated radiofrequency field, a hearing sensation results. This sensation was investigated by holding a small circular metal probe close to the skull. The probe was then excited at a radiofrequency of 3.5 megacycles. The audiofrequency components of the field existing between the probe and the head produced the threshold electromechanical pressures necessary for hearing. These electromechanical pressures were computed and compared to the pressures on the skull which were necessary to produce bone conduction hearing. These pressure values fall within the same limits, and produce a similar characteristic threshold curve. This leaves little doubt that the investigated hearing phenomenon is caused by the bone conduction mechanism. Author

N65-16669# Tactical Air Command, Langley AFB, Va.

OPERATIONAL TEST AND EVALUATION OF HIGH ALTITUDE LOW OPENING (HALO) PARACHUTE TECHNIQUES

Charles J. Corey, Marvin L. Payne, Medney E. Tardy, and Sven E. Wallin Nov. 1964 75 p

(TAC-TR-63-18; AD-452569)

A test was conducted with 14 parachutists and a C-130B aircraft to evaluate the parachuting of small teams of select parachutists at extremely high altitudes into remote areas, using the high altitude low opening (HALO) techniques established for altitudes up to 25000 feet. The feasibility of introducing small units into a combat area by HALO techniques was proven. Several modifications to the existing procedures, as well as additional crew and equipment, were required. The modifications and requirements, as well as recommendations for future HALO operations, are included in this report. Author

N65-16700# Vanderbilt Univ., Nashville, Tenn.

STUDIES IN ABSTRACTION LEARNING. VII: A SIMULATED CLASSROOM STUDY OF RETROACTIVE INHIBITION AS A FUNCTION OF THE METHOD OF TRAINING ON THE INTERPOLATED TASK

Leland E. Thune and Charles J. Long Jun. 1964 86 p refs (Contract Nonr-2149(01))

(TR-11; AD-608482)

Studies were conducted to determine the effect of retroactive inhibition on the performance of a person who is trained to operate one complex device, shifted to a different but related device, and then returned to the original device. The task of learning to operate two different makes of desk-calculators was selected for the study; 140 students were divided into 5 treatment groups, 2 experimental and 3 control, then subdivided into classes of 7 subjects each. The classes received various types and sequences of instructions, then were given proficiency tests. The results of the studies demonstrated the superior transfer effectiveness of conceptual training compared to direct machine practice, and showed that the superior transferability of abstraction learning is applicable to the learning of complex-conceptual–motor skills in a simulated classroom setting. D.S.G.

N65-16730 Joint Publications Research Service, Washington, D. C.

METHODS OF MEASUREMENT AND ANALYSIS OF BIOELECTRIC POTENTIALS

V. A. Kozhevnikov *In its* Current Probl. of Electrophysiol. Invest. of the Nervous System 9 Feb. 1965 p 94–111 refs (See N65-16726 07-04) OTS: $4.00

Automatic measurement of biopotential intensity, automatic frequency analysis, correlation analysis, and probability methods of analysis are discussed. When measuring the voltage of electrical oscillations, mean and effective values of amplitude can be obtained. Amplitude values are normally determined directly from the oscillograms, but, in addition, mean values can be measured automatically. The methods of so-called correlation analysis are the basis for studying the time properties of complex oscillations. The correlation functions show statistically the mean degree of interrelation between two instantaneous values of the amplitude processes under investigation, as a function of the distance on the time axis between these values. E.E.B.

N65-16753# Office of Naval Research, Washington, D. C.
VERTICAL ORIENTATION IN A HOMOGENEOUS ENVIRONMENT
William Metlay, Milton S. Katz, Paul A. Cirincione, and Gilbert C. Tolhurst 12 Oct. 1964 15 p refs
(NAVTRADEVCEN-IH-19; AD-608568) OTS: $1.00

Since earlier work investigating the problem of target acquisition and positioning adjustment in a homogeneous environment was directed at horizontal accuracy, the present study was conducted to define possible relationships between the ability to position a target in the vertical axis and in the horizontal. Four subjects were required to reposition, to geometric center, three targets which originated from six locations, in the vertical axis. In addition, subjects were also required to reposition one of the targets along the horizontal axis. The results for vertical and horizontal accuracy could not be determined separately since vertical and horizontal trials were interspersed in the same experimental series. However, what was shown clearly was that feedback, in terms of knowledge of where geometric center is located, can significantly affect vertical and horizontal positioning. Author

N65-16793# Space Technology Labs., Inc., Los Angeles, Calif.
HUMAN ENGINEERING OR ENGINEERING OF THE HUMAN—WHICH?
Robert S. Pogrund [1964] 42 p refs
(AD-608798) OTS: $2.00

The degree of compromise between the human engineer and the physiologist is a function of space flight duration. Short trips will permit the designing of the space capsule and its internal environment with a minimal degree of comfort to the human passenger. Medium length trips of interplanetary magnitude will require a duplicate of man's comfortable terrestrial environment, if he is to operate optimally as a scientific observer, capable of high performance levels. Extended interstellar space travel may not require the presence of incessant human intelligence, so that aids for ultimate survival are drawn from considerations of pharmacologic agents, hypothermia, adaptation, and yoga. Author

N65-16798# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OVERLOAD CENTRIFUGE FOR EXAMINING FLIGHT PERSONNEL
Z. Bielicki, S. Haduch, and S. Etmanowicz 19 Nov. 1964 8 p Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), no. 8, 1963 p 59–63
(FTD-TT-64-70/1+2; AD-452367)

Described are the mechanical construction and operational procedure of a human centrifuge that reaches from 1 to 30 g at normal or reduced atmospheric pressure under conditions of effective overloads. The centrifuge records the endurance of the human organism to the simultaneous effects of high altitude and overloads. Position variations of the cabin and the chair in the centrifuge allow accelerations in negative, positive, or transverse directions. The direction of the overload effect is established prior to the start of the centrifuge by attachment of the balancing weights in a desired point of the cabin. G.G.

N65-16810*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
STUDIES OF MANUAL CONTROL SYSTEMS Progress Report No. 5, 19 Jul.–18 Oct. 1964
1 Dec. 1964 41 p refs
(Contract NASw-668)
(NASA-CR-60697) OTS: HC $2.00/MF $0.50

Four groups of experiments were conducted to investigate (1) the difference between single-axis and two-axis performance for input signals of various bandwidths; (2) the difference between single- and two-axis tracking for controlled elements of various complexities; (3) the effect on two-axis performance of input coupling; and (4) the effects of output coupling. A single, highly experienced tracker was used. The results of these experiments indicated that with sufficient training the tracker can control each axis of a two-axis situation as well in either axis in a single-axis task when the conditions on the two axes are the same. Furthermore, the effects of input coupling can be greatly reduced with practice. Author

N65-16816*# Office of Naval Research, Washington, D. C.
[STUDIES OF AUDITORY INFORMATION PROCESSING EMPHASIZING THE APPLICATION OF SIGNAL DETECTABILITY THEORY TO THE AUDITORY SENSORY RESPONSES Second Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Lloyd A. Jeffress 13 Jan. 1965 37 p refs
(NASA Order R-129; Contract Nonr-3579(04))
(NASA-CR-60441) OTS: HC $2.00/MF $0.50

Brief reports are given of work on three problems: receiver operating characteristics for visual detection, detection by multiple observers, and detection and response latency. The texts of four papers given at the October 1964 meeting of the Acoustical Society of America are presented: *Effect of Phase Difference Between Signal and Masker on the Detection of a Narrow-Band Noise Signal, Receiver Operating Characteristics by Rating Scale for Antiphasic Stimulation, Theoretical and Obtained ROC Curves for Antiphasic Stimulation,* and *Auditory Sensitization and the Method of Interpolated Trials.* R.L.K.

N65-16878# San Diego State Coll., Calif. Dept. of Psychology
LEARNING SET PERFORMANCE OF SQUIRREL MONKEYS AFTER RAPID DECOMPRESSION TO VACUUM
Duane M. Rumbaugh and Joseph W. Ternes Brooks AFB, Tex., School of Aerospace Med., Oct. 1964 12 p refs
(Contract AF 41(609)-2281)
(SAM-TDR-64-42; AD-455372)

The experimental program entailed decompression of squirrel monkeys, *Saimiri sciureus,* to near vacuum (less than 2 mm Hg abs), and 6 days later, testing their capacity to perform a complex behavioral task learned prior to decompression. The behavioral task used is known as learning set, and is believed to be representative of the higher order mental processes characteristic of man. The major results were these: (1) No loss in learning set performance was detected among survivors. (2) Two animals died during or immediately after decompression, one in the group that was exposed

to vacuum for 11 seconds, and one in the group that was exposed to vacuum for 90 seconds. (3) Animals in the more severe decompression groups required much more time to recover to apparent normality than animals of the other groups. They were less inclined to eat and drink within the first few hours after decompression and, also, lost significantly more weight than the other animals, particularly those under control conditions. Short-term interferences with vision and hearing was noted. (4) It was concluded that if life be spared, restoration of function is promising and to be expected in full measure. Author

N65-16879# Texas Univ., Austin.
STUDY OF A PHOTOSYNTHETIC GAS EXCHANGER. A QUANTITATIVE REPETITION OF THE PRIESTLY EXPERIMENT
James H. Eley, Jr. and Jack Myers Brooks AFB, Tex., School of Aerospace Med., Sep. 1964 35 p refs Submitted for Publication
(Contract AF 41(609)-1556)
(SAM-TDR-64-52; AD-455393)

The degree of balance achievable in gas exchange between an illuminated plant (*Chlorella*) and an animal (mouse) was studied. In the experimental design, carbon dioxide and oxygen analyzers allowed the respiratory activity of each to be measured independently and the concentration to be monitored when the components were coupled together. Microbial gas exchange was minimized by maintaining the bottom of the mouse chamber at low humidity. Constant internal pressure was provided by a pressure sensor and a variable volume component. Leakage was quantitatively measured by periodic mass spectrometer analyses on the high argon, low nitrogen system gas. With the above procedures, gas analysis on the closed system could be precisely measured. The maximum degree of balance achieved was 98% in a 24-day closed run. System performance during the run was measured using gas exchange, algal growth rate, and comparison with performance predicted from analyses on the algal cells produced. Author

N65-17007# Air Force Systems Command, Bedford, Mass. Decision Sciences Lab.
THE MODIFIABILITY OF DECISIONS MADE IN A CHANGING ENVIRONMENT
Richard S. Gibson and Elizabeth H. Nicol Dec. 1964 39 p refs
(ESD-TR-64-657; AD-610122)

This research questions whether or not a decision maker's sensitivity to incoming information undergoes any change after he has reached a decision. A dynamic decision task, embedded in a limited war context, was presented to the subject who was required to assess simulated reconnaissance reports and to estimate the location of the enemy's main force. After a certain number of trials in which the information samples pointed to one of the alternative locations, the subject was then presented with a growing body of contraindicative information. With this task, an experimental study of the factors influencing decision modification was designed to test the effect of three main variables: the nature of the original condition, the length of time over which expectations were built up, and the amount of change represented in the shift from the initial condition to the postdecision situation. The facility with which the subject modified his decision was inversely related to the amount of situational change and the amount of experience in the situation before a change was introduced. The results indicated also that more information is required to change a decision than is originally needed to make the decision. Comparison of the subjects' performance scores with those of an ideal Bayesian observer showed highly significant correlations, although the Bayesian predictions were on the average significantly better than the subjects' predictions. Author

N65-17012# Catholic Univ. of America, Washington, D. C.
PREDICTING DECISION MAKING BEHAVIOR FROM PERSONALITY AND COGNITIVE VARIABLES Final Report
John C. Townsend and Walter J. Smith Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1964 71 p refs
(Contract AF 19(628)-2822)
(ESD-TDR-64-619; AD-610521)

In an attempt to write multiple regression equations predicting decision making behavior from personality and cognitive variables, a pilot study and a main study were conducted. Unselected, undergraduate college males and females from two separate universities served as subjects. Predictor groups of variables for each of 13 categories of decision making criteria were hypothesized. The results indicated that seven of the multiple regression equations through their beta coefficients yielded multiple correlation coefficients significant at $P<.01$, three at $P<.05$ and three at $P>.05$. All of the multiple correlations related to the prediction of goodness of decision were significant beyond the 0.01 level. The least profitable predictions resulted from attempts to predict decision time. Predictions of confidence in decision were intermediate. The largest amount of criterion variance accounted for was 16%. Low multiple correlation coefficients were expected due to the restricted range of personality and cognitive scores in persons normal in personality and above average in intelligence. Similar research in which normal individuals would be subjected to stress to reveal underlying personality differences is indicated. Author

N65-17069*# Martin Co., Baltimore, Md. Research Dept.
CHEMOSYNTHETIC GAS EXCHANGER Second Quarterly Progress Report, Sep. 3–Dec. 17, 1963
Leonard Bongers [1963] 19 p refs
(Contract NASw-713)
(NASA-CR-55188; ER-13270-2) OTS: HC $1.00/MF $0.50

The effect of oxygen upon growth rate, conversion efficiency, and cell composition was investigated. The effect of N-limited (nitrogen limited) growth on hydrogen bacteria is also discussed. R.T.K.

N65-17138# Ohio State Univ., Columbus.
A FACTOR ANALYTIC APPROACH TO HUMAN ENGINEERING ANALYSIS AND PREDICTION OF SYSTEM MAINTAINABILITY Final Report, Jan.–Jun. 1964
Donald A. Topmiller (Ph.D. Thesis) Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 88 p refs
(AMRL-TR-64-115; AD-610210)

A theoretical formulation is outlined which treats the measurement and prediction of system maintainability as a "components-of-variance" model. The sources of variance are identified as inter- and intra-man (personnel and social variables); machine (weight, volume, reliability, etc.) and man–machine interaction (human engineering design criteria). A restricted case of the formulation was investigated empirically in an attempt to predict maintainability of a sample of Air Force equipment from a questionnaire evaluation of the human engineering design features. The questionnaire contained 114 items concerning desirable human engineering maintainability design features. Questionnaire responses, factor-analyzed by the Wherry–Winer Method, yielded eight orthogonal (independent) maintainability design factors. On the basis of the obtained factor loadings, seven of the original eight factors were selected as the most potent predictors. Several regression

analyses were performed using different assumptions concerning both heterogeneity of sampled equipment and questionnaire scale stability. Author

N65-17144# Mitre Corp., Bedford, Mass.
FURTHER RESEARCH ON THE EFFECT OF VIEWING ANGLE AND SYMBOL SIZE ON READING EASE
G. Kinney, S. Manning, and L. Smith Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1965 21 p ref
(Contract AF 19(628)-2390)
(W-07004; ESD-TDR-64-633; AD-610421)

The effects of viewing angle and visual symbol size upon the time required to read familiar words were studied for angles of 90, 60, 45, and 30 degrees and for symbols whose height subtended 16 and 10 minutes of arc at the viewer's eyes. Recommendations for large-board, wall-display layout and viewer-seating arrangements are presented. Author

N65-17173# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BOOK REVIEW ON: "INFORMATION AND VISION"
N. D. Nyuberg 5 Dec. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 7, 1962 p 123–125
(FTD-TT-64-401/1; AD-610273)

The book is acknowledged to be one of only a few in the field, but its merits are glossed over. The hypothesis presented in the book of a volley of impulses in the optic nerve fiber as a result of a change in the dimensions of the receptive fields is regarded as purely speculative and is said to be without any solid basis. The book's consideration of the visual system as an ideal Shannon system is also challenged. Other points that are questioned include perception of contours, eye movement descriptions, brightness vs information content, the approach to ideality of the visual system, and the transmission rate capacity of the visual analyzer. The chief value of the book is asserted to lie in its stimulating treatment of numerous questions, rather than in what are called its debatable affirmations and indefinite conclusions. D.E.W.

N65-17242# Naval School of Aviation Medicine, Pensacola, Fla.
AN INVESTIGATION OF UNPREDICTED DIFFERENCES IN ATTRITION RATES AMONG STUDENTS FROM DIFFERENT PROCUREMENT SOURCES
Robert J. Wherry, Jr. and Charles W. Hutchins, Jr. 9 Oct. 1964 17 p refs
(BUMED-40; AD-609668)

An investigation of unpredicted differences in attrition rates among men from different procurement sources is described. Those differences found were analyzed for contributing factors. Suggestions are made as to the application of these factors in improving those procurement sources showing the higher attrition rates. Author

N65-17304# Joint Publications Research Service, Washington, D. C.
COPING WITH SILENCE IN OUTER SPACE
V. Lebedev and O. Kuznetsov 26 Feb. 1965 9 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), Oct. 1964 p 59–64
(JPRS-28929; TT-65-30405) OTS: $1.00

Isolation chamber experiments on humans with restricted stimuli were conducted and showed that healthy individuals with high motivation can remain in isolation for a long time without any psychic changes that endanger their health. The uniformity and monotony of impressions in the absence of external stimuli reduce the energy level of the cerebral cortex and lead to illusions of recognition of eidetic sensations, but not hallucinations. This intensification of brightness of imagery under isolation conditions is due to the reduced flow of stimuli impinging on the human sensory organs. An understanding of the fundamentals of space and aviation psychology, planned purposeful activity during space flight, as well as good health and high motivation are recommended measures to combat sensory confusion and other isolation psychological phenomena. G.G.

N65-17310# Joint Publications Research Service, Washington, D. C.
CYBERNETICS—PHILOSOPHICAL AND SOCIOLOGICAL PROBLEMS
I. Novik 20 Jan. 1964 217 p refs Transl. into ENGLISH of the book "Kibernetika—Filosofskiye i Sotsiologicheskiye Problemy" Moscow, State Political Lit. Publishing House, 1963 p 1–207
(JPRS-22814; OTS-64-21340) OTS: $3.50

Social, scientific-technical, and theoretical conditions led to the emergence of the new science of cybernetics. This new science is characterized by a generic and abstract approach to control with the aid of a signaling action. This distinguishes it from automatic control, effected in the past, to presuppose direct mechanical communications, nexus and contact. Cybernetics is directly bound to optimization. An analysis of the interrelationship of man and machine led to the conclusion that the use of cybernetic machines will contribute to raising the cultural-technical level of mankind. G.G.

N65-17326*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A THEORY FOR THE OPTIMAL DETERMINISTIC CHARACTERIZATION OF THE TIME-VARYING DYNAMICS OF THE HUMAN OPERATOR
Walter W. Wierwille and Gilbert A. Gagne Washington, NASA, Feb. 1965 68 p refs
(Contract NAS1-3485)
(NASA-CR-170) OTS: HC $3.00/MF $0.75

A deterministic theory of characterization is presented which can be used to determine the time-varying dynamics of the human operator engaged in a tracking task. With this theory, it is possible to obtain a time-varying impulse response and a time-varying transfer function which represent the action of a human operator in an open- or closed-loop control system. No special form of input is required. The characterization, which may be developed for either real-time or nonreal-time computation, is based upon an exact theory of fixed-form optimization. A strongly convergent, definitely stable, iteration technique can be used to realize the optimal characterization filter. The theory takes the time variation of the impulse response or transfer function into account, so that it is unnecessary to make the assumption of slowly varying dynamics. Author

N65-17329*# Massachusetts Inst. of Tech., Cambridge.
REMOTE MANIPULATION WITH TRANSMISSION DELAY
William R. Ferrell Washington, NASA, Feb. 1965 120 p refs
(Grant NsG-107-61)
(NASA-TN-D-2665) OTS: HC $4.00/MF $0.75

If a remote manipulator is located at a great distance from a person using it and monitoring its activity, limited signaling speed will result in a time discrepancy between the operator's control activity and the feedback he gets concerning the response of the distant equipment. The work reported represents the results of a program of exploratory research into the effects of such a delay on an operator's ability to perform self-paced manipulation tasks with a manipulator which duplicates his hand motions. It was found that even complex tasks could be accomplished by adopting a simple strategy of performing

the task by a series of discrete, open-loop movements. No evidence of unstable motions or of delay-induced emotional stress was observed. Since this strategy was consistently used, it was found possible to predict task completion time in the delay case from measures of operator–manipulator performance when there was no delay. The ability to perform without visual feedback, open-loop, was separately investigated. Author

N65-17438# School of Aerospace Medicine, Brooks AFB, Tex.
HUMAN FACTORS ASPECTS OF A 30-DAY EXTENDED SURVIVABILITY TEST OF THE MINUTEMAN MISSILE
Bryce O. Hartman, Don E. Flinn, A. B. Edmunds, F. D. Brown, and J. E. Schubert (Boeing Co., Seattle) Oct. 1964 25 p refs
(SAM-TDR-64-62; AD-456174)

Two civilian subjects successfully completed 30 days of unbroken confinement in an underground Minuteman launch control center with an open-loop air supply. Logistic supplies were self-contained. During the test, they ate, slept, and performed duties similar to those that would be required of an operational crew in a postnuclear attack environment. Their performance score was high (99.75% level) with no critical errors. Morale throughout the test was excellent, with minimum of interpersonal friction. No physiologic or psychologic changes were observed which would compromise the integrity of the weapon system. Alterations in sleep patterns obtained were consistent with predictions based on work levels. Author

N65-17468# George Washington Univ., Washington, D. C. Human Resources Research Office
PROGRAMED INSTRUCTION AND LOW ALTITUDE AERIAL OBSERVATION
Peter B. Dawkins Dec. 1964 56 p refs
(Contract DA-44-188-ARO-2)
(HUMRRO-RR-14; AD-456738)

An Army training course on low altitude aerial observation was converted into programed format. The programed content consisted of both verbal and visual (i.e., photographs and maps) material on four basic aerial observer skills. Criterion testing on target location indicated that the group of students receiving the experimental training made reliable learning gains, in comparison with a control group which did not receive the training. A reduction in time required to locate targets accompanied the increase in accuracy. On the average, study time for the self-paced programed courses was less than that required for the classroom version of the course (15 hours vs 16 hours). Author

N65-17492# Joint Publications Research Service, Washington, D. C.
REVIEW OF SOME WORKS NOMINATED FOR 1965 LENIN PRIZES: MORPHOLOGICAL STUDIES OF FISH AID AIRCRAFT AND SHIP DESIGNERS
26 Feb. 1965 7 p refs Transl. into ENGLISH from Izv. (Moscow), 16 Jan. 1965 p 3
(JPRS-28910; TT-65-30393) OTS: $1.00

The role of the study of the functional morphology of fish in the design of underwater craft of diverse types is discussed. Relationships are noted between external structures of fish and recent designs for naval and air craft, including fins to control vertical direction, and lifting configurations of the fish body or the airplane fuselage. The importance of these to the progress of technology is cited as a reason for awarding the Lenin Prize. D.E.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-16375# University Coll. of Wales, Aberystwyth. Edward Davies Chemical Lab.
INFRA-RED DISPERSION STUDIES. PART 2: METHYL IODIDE Scientific Report No. 11
W. H. Prichard and W. J. Orville-Thomas 27 Sep. 1964 21 p refs
(Contract AF 61(052)-691)
(AFCRL-65-11; AD-610311)

The dispersion curve for liquid methyl iodide has been measured between 2μ and 20μ using an interferometric method. The refractive index data have been analyzed to yield the infrared intensities of all fundamental vibration bands. The results are used in conjunction with a resonable (quadratic) potential function to obtain dipole moment derivatives with respect to bond lengths and bond moments. The parameters obtained are compared with those obtained for methyl iodide in the vapor state. Author

N65-16376# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF SCHOOLS OF HIGHER EDUCATION: NONFERROUS METALLURGY
31 Aug. 1964 209 p refs Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zaved., Tsvet. Met. (Ordzhonikidze), vol. 6, 1963 p 1–166
(FTD-MT-64-172; AD-608082)

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19. ELECTROLYTIC ETCHING AND POLISHING OF A TUNGSTEN-RHENIUM ALLOY V. I. Layner, K. N. Usol'tseva, and V. N. Parusnikov p 164–172 refs (See N65-16386 07-17)

20. INFLUENCE OF SOLUTION DECOMPOSITION ON THE RECRYSTALLIZATION OF Al-Cu ALLOYS M. V. Stepanova and V. Ye. Mogilevskaya p 173–179 refs (See N65-16387 07-17)

21. INFLUENCE OF TEMPERATURE AND RATE OF DEFORMATION ON THE MECHANICAL PROPERTIES OF L62 BRASS N. P. Ageyev p 180–189 refs (See N65-16388 07-17)

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23. METHOD FOR THE CALCULATION OF NORMS OF UNCOMPLETED PRODUCTION IN SHOPS PRODUCING REFRACTORY METALS FOR THE ELECTROVACUUM INDUSTRY A. G. Rutenburg, A. D. Gokhshtand, A. I. Kaz'min, and Yu. I. Proskurovskaya p 197–202 refs (See N65-16390 07-17)

24. SEVENTEENTH SCIENTIFIC AND TECHNICAL CONFERENCE OF STUDENTS OF MOSCOW INSTITUTE OF STEEL AND ALLOYS A. N. Krestovnikov and F. A. Gimel'farb p 203–207

N65-16377 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE THERMODYNAMIC PROPERTIES OF A Cu–Sb BIMETALLIC SYSTEM BY THE EMF METHOD

A. N. Krestovnikov and A. L. Lomov *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 96–106 refs (See N65-16376 07-06)

The Cu–Sb system by the emf method in the copper atomic fraction region from 0.0485 to 0.9013 and the temperature range 1115° to 1215° K was studied, and a total of 18 melts were investigated. From the emf values of the concentration chains $-Cu|\,CuCl,\ KCl\text{–}NaCl|\,[Cu(N_{Cu})\text{–}Sb(N_{Sb})]^{+}$ the activity coefficients of copper at temperatures of 1115° to 1215° K were calculated. For the copper concentrations (at intervals of $0.1N_{Cu}$), the values of $\Delta\bar{Z}_{i\ exc}$, $\Delta\bar{H}_{i}$, $\Delta\bar{S}_{i\ exc}$ at 1215° K for copper and antimony, as well as the integral values for one mole of the binary melt, were calculated. The system exhibits large negative deviations from the ideal rule. Additional studies showed: (1) Cu–Sb melts are formed with an evolution of heat. The minimum value of $\Delta 11$ is 1385 cal/g-atom at 1215° K and $N_{Cu} = 0.75$. (2) Cu–Sb melts are characterized by considerable positive excess entropies of mixing; this may be explained by the great difference in the atomic volumes of the components. Author

N65-16378 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POTENTIALS OF LEAD IN MELTS OF A MIXTURE OF SODIUM AND POTASSIUM CHLORIDES CONTAINING ITS IONS

I. F. Nichkov, S. P. Raspopin and S. V. Karzhavin *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 107–112 refs (See N65-16376 07-06)

A measurement was made of the equilibrium potentials of lead in the temperature range 700° to 850° in melts of an equimolecular mixture of sodium and potassium chlorides containing from 0.13% to 50.0% by weight $PbCl_2$. It was shown that Pb^{2+} interacts weakly with the electrolyte if its ionic proportion with respect to the total number of cations does not exceed 3% (this corresponding to a content of 11.4% by weight $PbCl_2$ in the electrolyte). It was also found expedient to use an electrolyte containing 1% to 3% by weight $PbCl_2$ for lead comparison electrodes. Author

N65-16379 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTRICAL CONDUCTIVITY OF INDUSTRIAL ALUMINUM-BATH ELECTROLYTE WITH ADDITIONS OF MgF_2 AND NaCl

S. V. Tararin and A. I. Belyayev *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 113–119 refs (See N65-16376 07-06)

Addition of up to 5% NaCl to an industrial electrolyte containing 3–3.5 MgF_2 reduces the electrolysis temperature and simultaneously increases conductivity by approximately 3%. The rate at which the conductivity of the electrolyte χ varies when its temperature changes, equal to 8% to 10% per 10° under industrial conditions, was found to be greater than that indicated by laboratory data. Author

N65-16380 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF AUTOMATIC REGULATION ON THE ELECTROLYTE TEMPERATURE OF ALUMINUM BATHS

A. A. Vol'berg and A. I. Belyayev *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 120–124 refs (See N65-16376 07-06)

Measurements were conducted, both with and without regulation, in the same bath, and only those of the curves obtained that differed little from the initial electrolyte temperature and cycle time were selected for comparison. This was done to avoid the influence of varying bath cooling during treatment on the rate at which the electrolyte temperature rose. It was concluded that (1) there is no thermal equilibrium during the period between cyclic treatments in electrolyzers, because the electrolyte temperature rises even when they operate at a constant electrolyte resistance; (2) under the conditions of continuous alumina delivery, thermal equilibrium occurs in the bath 10 to 12 hours

after cyclic treatment; and (3) the rate of the increase in electrolyte temperature is 2.5 times greater in the absence of regulation than with regulation, as a result of the additional heat intake caused by the increase in electrolyte resistance and the rise in back emf. Author

N65-16381 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF CONDITIONS FOR OBTAINING THE LOWER CHLORIDES OF TITANIUM AND ZIRCONIUM
G. A. Meyerson, A. B. Suchkov, Yu. G. Olesov, and T. N. Yermakova *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 125–134 refs (See N65-16376 07-06)

Methods were developed for preparing electrolytes containing titanium and zirconium ions of lower valences for the electrorefining of titanium and zirconium; these include the cementation method and anodic dissolution in the presence of a more electropositive metal. Cementation is the most expedient electrolyte-preparation method for titanium refining, while the dissolved-anode method is best for refining zirconium. In both cases, it is best to use a mixture of sodium chloride and divalent iron as the initial salt melt. Both methods make it possible to prepare the electrolyte directly in the electrolyzer. Author

N65-16382 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM BETWEEN MOLYBDENUM AND ITS IONS IN MOLTEN POTASSIUM CHLORIDE
O. A. Ryzhik and M. V. Smirnov *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 135–144 refs (See N65-16376 07-06)

The principal results of an analysis of the equilibrium between molybdenum and its ions in molten potassium chloride made by the emf method are presented. The experiments reduced to measurement of the equilibrium potentials of molybdenum with respect to a chlorine comparison electrode in hermetically sealed cells as functions of temperature and concentration. The first type of cell was a wide quartz test tube. The equilibrium potentials of molybdenum were measured in molten potassium chloride containing from 0.51% to 9.63% by weight Mo, in the temperature range 780° to 940° C. On the basis of the experimental data, the expressions were calculated for the standard electrode potentials $E^{\circ}_{Mo|Mo^{3+}}$, $E^{\circ}_{Mo|Mo^{2+}}$, and $E^{\circ}_{Mo^{2+}|Mo^{3+}}$ relative to the chlorine comparison electrode as functions of temperature and determined the equilibrium constants of the reaction $2Mo^{3+} + M \rightleftarrows 3Mo^{2+}$ in a KCl melt. The thermodynamic parameters were evaluated of the reactions of molybdenum dichloride and trichloride with molten potassium chloride. Author

N65-16384 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SORPTION OF IRON (III) FROM FLUORINE-CONTAINING SOLUTIONS BY THE ANIONITES AV-17, EDE-10P, AND AN-2F
V. S. Pakholkov and V. V. Rylov *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 149–157 refs (See N65-16376 07-06)

The sorption of trivalent iron from HF, HCl, H_2SO, HCl-HF, and H_2SO_4-HF solutions by anionites of varying alkalinity was studied. It was established that of the anionites studied, the strongly alkaline anionite AV-17 does not sorb iron from hydrochloric acid and sulfate solutions, in the presence of any quantity of HF. The negligible sorption of iron from HCl-HF and H_2SO_4-HF solutions by anionites is used to purify titanium, zirconium, vanadium, niobium, and several other elements. Author

N65-16385 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PURIFYING BARIUM COMPOUNDS OF CALCIUM IMPURITIES BY ZONE MELTING
M. V. Mokhosoyev and T. T. Got'manova *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 158–163 refs (See N65-16376 07-06)

The experiments conducted on zone purification of selected mixtures showed that this method makes it possible to reduce significantly the calcium-impurity content in barium compounds. Thus, an initial calcium content of 0.018% was reduced to 0.00126% after 5 zone passes at a rate of 30 mm per hour. The effective coefficients of calcium-impurity distribution under various regimes for the zone melting of eutectic mixtures of $Ba(NO_3)_2 + KNO_3$ and $Ba(NO_3)_2 + BaCl_2$ were determined. The influence of certain impurities on the effective coefficient of calcium-impurity distribution during the zone purification of a eutectic mixture of $Ba(NO_3)_2 + KNO_3$ was studied. The presence of a magnesium impurity enhances purification to some extent. A eutectic mixture of $Ba(NO_3)_2 + KNO_3$ was employed for the purification of barium compounds from calcium impurities; after purification of this mixture a high-purity barium compound may be obtained. Author

N65-16411# Copenhagen Univ. (Denmark). Chemistry Lab. III
THEORY OF CHEMICAL KINETICS
Thor A. Bak, Svend Erik Nielsen, Knud Andersen, and Carl Nyeland 16 Sep. 1963 64 p refs
(Contract AF 61(052)-133)
(ARL-63-211; AD-422731)

A three-dimensional hard sphere model for dissociation of diatomic molecules is presented. Agreement with experimental values is satisfactory. A numerical solution to the problem of translational relaxation in hard sphere gas is given, and a quantum mechanical theory of exchange reactions is presented. Author

N65-16471# Pennsylvania Univ., Philadelphia. Johnson Research Foundation
TEMPERATURE JUMP STUDIES IN THE NANOSECOND RANGE Final Report
George Czerlinski [1964] 13 p refs
(Contract Nonr-551(46))
(AD-451466)

Temperature jumps within nanoseconds were produced by absorption of some of the light from a Q-switched ruby laser. Such temperature jumps were applied to nonbiological (but chemically connected to biological) systems—bromthymoleblue as a pH indicator, and methyleneblue as an electron-transfer indicator. Although methyleneblue was not originally intended to be used for the purposes of detection, it behaved abnormally at high light-power densities, and further investigation was made of this compound. Two papers describing the results of the work are presented: *Nanosecond Heating of Aqueous Systems by Giant Laser Pulses*, and *Reduced Absorption of Light at High Laser Power Densities*. Also described are investigations of neodymium-doped crystals, feasibility tests of temperature jump cells with heating by giant laser pulses, and studies of rapid detection of laser temperature jumps. D.S.G.

N65-16559# Monsanto Research Corp., Everett, Mass.
RESEARCH ON ORGANIC DEPOLARIZERS Final Report, 1 Jul. 1961–30 Jun. 1964
B. A. Gruber, E. A. Mc Elhill, and D. L. Williams [1964] 184 p refs
(Contract DA-36-039-SC-87336)
(MRB4006F; AD-454913)

About 200 organic compounds were tested as cathode materials. The results are tabulated for both experimental and theoretical coulombic capacities, and for both load and open-circuit potentials. The best depolarizers generally belong to one of the following groups: nitro compounds (RNO_2), positive halogen compounds (ROX and RNX), halogen addition compounds (R_3NX_2) or peroxides (ROOR). The positive halogen compounds and the halogen addition compounds discharge at high potentials with high efficiencies even at high drain rates. However, most positive halogen compounds have only limited stability in water. Certain peroxides have relatively high load potentials and are efficiently reduced, but their theoretical capacity is limited. Because of their high energy and coulombic capacity, nitro compounds were studied most intensively. Author

N65-16575# Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary, Oct. 1–Dec. 31, 1964
J. B. Beal, Jr. and C. Pupp 25 Jan. 1965 16 p refs
(Contract AF 04(611)-9556; ARPA Order 24)
(AD-455834)

Experimental difficulties encountered in the electrolysis of melts of fluoride–nitrate mixtures are described, which were due principally to the attack on the anode. The preparation of sodium hyponitrite and its reaction with chlorine in a carbon tetrachloride solution were investigated. Two types of studies on oxygen difluoride were conducted–one to measure the conductivity of liquid OF_2 (neat) and of various mixtures in which OF_2 is the solvent, and the other to determine if Lewis acid-base adducts were formed at low temperatures. D.S.G.

N65-16585*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MASS SPECTROMETRIC INVESTIGATION OF REACTIONS OF OXYGEN ATOMS WITH HYDROGEN AND AMMONIA
Edgar L. Wong and Andrew E. Potter, Jr. Washington, NASA, Feb. 1965 27 p refs
(NASA-TN-D-2648) OTS: HC $1.00/MF $0.50

The reactions of atomic oxygen with hydrogen and with ammonia were studied in the near absence of molecular oxygen. A stirred reactor was used to make reaction rate measurements, and the gases from the stirred reactor were analyzed with a time of flight mass spectrometer. Quantitative analyses of atomic oxygen as well as several of the reaction products were performed with this instrument. The reaction rate of the hydrogen–atomic oxygen ($H_2 + O$) reaction was investigated in the temperature range 400° to 600° K. Analysis showed that the only detectable products of the reaction were molecular oxygen, water, and atomic hydrogen (O_2, H_2O, and H). The reaction rate of the ammonia–atomic oxygen ($NH_3 + O$) reaction was investigated in the temperature range 350° to 600° K. Product analyses indicated that the stoichiometry of the reaction could be represented by $NH_3 + 4.4\ O \rightarrow NO + 0.5\,H_2 + 1.2\,O_2 + 1.0\,H_2O$. Author

N65-16635# Los Alamos Scientific Lab., N. Mex.
APPLICATIONS OF THE ELECTRON MICROPROBE TO CHEMICAL ANALYSIS
E. A. Hakkila, H. L. Barker, G. R. Waterbury, and C. F. Metz 29 Dec. 1964 70 p refs
(Contract W-7405-ENG-36)
(LA-3157) OTS: $3.00

The electron probe X-ray microanalyzer is a versatile tool for the analysis of areas as small as 1 micron in diameter. Some applications to the investigation of sample homogeneity, diffusion studies, identification of sample composition, and identification of inclusions are described. Author

N65-16660# Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.
EXTRACTION OF ALUMINUM FROM $2Na_2O{\cdot}3CaO{\cdot}5Al_2O_3$ IN WATER AND IN SOLUTIONS OF NaOH AND Na_2CO_3
R. V. Lundquist 1965 13 p refs
(BM-RI-6593)

The compound $2Na_2O{\cdot}3CaO{\cdot}5Al_2O_3$ occurs as a minor phase in lime-soda sinters prepared for extracting aluminum from siliceous aluminum-bearing materials. About 99% extraction of sodium and aluminum from synthesized $2Na_2O{\cdot}3CaO{\cdot}5Al_2O_3$ was obtained in solutions of $NaOH$–Na_2CO_3 at leaching temperatures of 50° C and above. Extractions in water were low because insufficient NaOH was generated by hydrolysis. Extractions in NaOH solutions were limited to about 80% owing to the precipitation of hydrated calcium aluminates. Rapid extractions of 100% were obtainable in Na_2CO_3 solutions, but the subsequent rapid precipitation of alumina trihydrate caused losses in alumina recovery. Author

N65-16663# International Union of Pure and Applied Chemistry, Basle (Switzerland).
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS
L. Brewer, comp. (Calif. Univ., Berkeley) 31 Dec. 1964 35 p refs
(Rept.-13)

N65-16674# Naval Civil Engineering Lab., Port Hueneme, Calif.
INVESTIGATION OF POSSIBLE METHODS FOR TESTING GAS FILTERS
J. R. Gilder 16 Nov. 1964 17 p refs
(N-659; AD-452746)

An investigation and literature search was made of activated charcoal, mercaptans, and the use of odors in testing gas penetration of carbon filters. Tests were performed on the detection of mercaptans, especially N-amyl mercaptan. It was found that the idea of using an odor to test filters may have merit, but mercaptans appear too hazardous for this purpose. There are, however, other sources of odor that can be investigated. Using human sense of smell for detecting gas leaks may be practical, but it is not as easy to do as it might appear. Most of the more quantitative methods that are being used at the present time lack sensitivity, but gas chromatography is worthy of further consideration. Author

N65-16706# Istituto di Ricerche Breda S.p.A., Milan (Italy).
QUANTITATIVE AUTORADIOGRAPHY. PART I: PREPARATION OF THE RADIOACTIVE STANDARDS WITH STEP-TYPE CONCENTRATION OF TRACER [AUTORADIOGRAFIA QUANTITATIVA. PARTE I: PREPARAZIONE DEGLI STANDARDS RADIOATTIVI A CONCENTRAZIONE SCALARE DI TRACCIANTE]
L. Matteoli, P. Logi, and S. Salamanna 1964 21 p refs In ITALIAN; ENGLISH summary
(EUR-1883.I) Available from the Belg. Am. Bank and Trust Co., N. Y. Account No. 22.186: 40 Belg. Fr.

A method for the preparation of radioactive standard films having uniform, constant thickness and using photographic gelatine as a support for the tracer is described. Details on the following points are reported: basic physicochemical properties of gelatine; preparation of slides for deposition of the gelatine–tracer solution; selection of lateral inserts, referring especially to the desired thicknesses; choice of suitable tracer concentrations and preparation of radioactive solutions; drying-up and preservation of obtained films; control of thickness and tracer distribution, mounting of standard series and selection of source supports. Some autoradiographies of the obtained standard series and the corresponding photometric traces are included. Finally, a method is described for the preparation of radioactive films having constant concentration and growing thickness (wedges), to ascertain the influence of thickness variations on the autoradiographic image of blackening for every employed radioisotope. As an example, the autoradiographies of two wedges of Ca^{45} are reported. Author

N65-16721# Joint Publications Research Service, Washington, D.C.
MOLTEN ALKALI-SULFATE SALTS AND Mg-Li MELTS IN SULFURIC ACID SOLUTIONS
9 Feb. 1965 20 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Ivanovo), no. 5, 1964 p 705–710, 810–815
(JPRS-28679; TT-65-30298) OTS: $1.00

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2. CORROSION STABILITY AND ANODIC BEHAVIOR OF Mg-Li MELTS IN CONCENTRATED SULFURIC ACID SOLUTIONS V. S. Poroykova, Yu. P. Khranikov, and A. G. Sokolova p 9–17 refs (See N65-16723 07-06)

N65-16722# Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE Li_2SO_4-Cs_2SO_4-H_2O SYSTEM
L. I. Pokrovskaya, V. Ye. Plyushchev, and G. P. Kuznetsova *In its* Molten Alkali-Sulfate Salts and Mg-Li Melts in Sulfuric Acid Soln. 9 Feb. 1965 p 1–8 refs (See N65-16721 07-06)
OTS: $1.00

The isothermal method was used to study solubility in the Li_2SO_4-Cs_2SO_4-H_2O system at 25° and 50° C. It was established that the isotherms of the ternary system at the two temperatures are identical and consist of four crystallization branches corresponding to separation of $Li_2SO_4 \cdot H_2O$ from the binary salts $3Li_2SO_4 \cdot Cs_2SO_4 \cdot 3H_2O$ and $Li_2SO_4 \cdot Cs_2SO_4$, and from Cs_2SO_4. The individuality of the compounds crystallizing in the system was determined by optical and X-ray phase methods of analysis. Thermographic and thermogravimetric methods of analysis established the dehydration of the compound $3Li_2SO_4 \cdot Cs_2SO_4\ 3H_2O$ within the 180° to 300° C range with its simultaneous decomposition into $5Li_2SO_4 \cdot Cs_2SO_4$ and $Li_2SO_4 \cdot Cs_2SO_4$. Author

N65-16723 Joint Publications Research Service, Washington, D.C.
CORROSION STABILITY AND ANODIC BEHAVIOR OF Mg-Li MELTS IN CONCENTRATED SULFURIC ACID SOLUTIONS
V. S. Poroykova, Yu. P. Khranikov, and A. G. Sokolova *In its* Molten Alkali-Sulfate Salts and Mg-Li Melts in Sulfuric Acid Soln. 9 Feb. 1964 p 9–17 refs (See N65-16721 07-06)
OTS: $1.00

The properties and anodic behavior of Mg-Li alloys differing in phase composition were studied in concentrated sulfuric acid solutions. It was shown that properties of alloys (microhardness, corrosion resistance, potential value, polarizability) are determined by the solid solution group (α, $\alpha+\beta$,β) to which the alloy belongs. Upon comparison with magnesium, ($\alpha+\beta$)-solid solutions have higher potential (0.1-0.15 volt more negative) and lower polarizability. The β-solid solutions have potentials 0.6 to 0.7 volt more negative than magnesium. Both magnesium and magnesium–lithium alloys exhibit a positive difference effect in concentrated sulfuric acid. The dissolution of lithium from alloys is proportional to the anodic current density. Author

N65-16754# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
ORGANIC COMPOUNDS OF THE ACTINIDES AND LANTHANIDES: A COMPILATION OF DATA IN THE LITERATURE
Linda Lou Smith Nov. 1964 45 p refs
(Contract AT(07-2)-1)
(DP-913) OTS: $2.00

A table of properties was compiled for some organic compounds of the actinide and lanthanide elements. The tabulated properties include appearance, melting points, boiling points, solubility data, stability, and molecular complexity. The majority of the compounds are β-diketone complexes, alkoxides, cyclopentadienides, or derivatives of these classes. Author

N65-16766# Vanderbilt Univ., Nashville, Tenn.
GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES, AND RELATED SUBSTANCES, AS SOURCES OF ANTI-RADIATION DRUGS Annual Progress Report, 1 Oct. 1963–30 Sep. 1964
L. Field, R. B. Barbee, J. D. Buckman, H. K. Kim, W. B. Lacefield et al [1964] 28 p refs Includes Interim Res. Rept. No. 20, 1 Jul.–30 Sep. 1964
(Contract DA-49-193-MD-2030)
(APR-3; AD-452560)

Twenty-two compounds were submitted for screening as antiradiation drugs. In the main, these were thiolsulfonates, aminodisulfides, sulfinic acid derivatives, and dithiocarbamyl derivatives. The structures of the materials were established, and their stabilities and general chemistry were investigated. Studies also were made on mercapto disulfides, dithiosulfites, and cyclic disulfides. The reaction of thiolsulfonates with thiols was the principal means for synthesis of the aminosulfides. Several of the drugs were active in protection capability against ionizing radiation. Author

N65-16775# Cornell Univ., Ithaca, N. Y.
ORGANIC ELECTRO-OXIDATIONS Final Report
D. H. Geske 31 Oct. 1964 8 p refs
(Grant AF-AFOSR-166-63)
(AFOSR-64-2249; AD-608754)

From a voltammetric examination of the oxidation of picrate ion in acetonitrile using a rotating bead platinum electrode, it was concluded that picrate ion undergoes a one-electron oxidation. Picric acid is reducible on a mercury electrode in acetonitrile at a half-wave potential of 0.07 V, and the diffusion current constant corresponds approximately to a one-electron process. A chronopotentiometric study of the electro-oxidation of picrate ion confirmed the one-electron oxidation for picrate ion. Electrolyzed solutions were also examined by titrimetry, polarography, and spectrophotometry. These examinations indicated the presence of picrate ion and some unknown species. A separation was accomplished by the addition of

aqueous sodium hydroxide. The upper acetonitrile layer gave an absorption spectrum identical to that of a known picrate solution. The lower layer was colored slightly brownish, apparently from the other products of the electrode reaction. On the basis of this evidence, it was postulated that the primary electrode reaction was the formation of the picryl radical. This radical is short lived and combines with hydrogen to form picric acid. E.E.B.

N65-16792# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
HIGH-TEMPERATURE ADHESIVES AND RESINS Quarterly Progress Report, 15 Jul.–15 Oct. 1964
Paul M. Hergenrother, Jerry L. Kerkmeyer, and Harold H. Levine Nov. 1964 32 p
(Contract NOw-64-0524-c)
(QPR-2; AD-452338)

High-density 2-ply polymide laminates were prepared with flexural strengths and moduli of 90300 psi and 2.72 × 10^6 psi at room temperature, and 53200 psi and 2.55 × 10^6 psi after 24 hours at 600° F (tested at 600° F), respectively. Poly (*m*-phenylene-3,3', 4,4'-benzophenonetetracarboxylimide) exhibited excellent thermal stability under isothermal conditions, retaining 77% and 33% of its weight after 150 and 250 hours at 700° F in static air. Low molecular weight polybenzothiazole was prepared by cyclizing a precursor polyamidethiol obtained from the reaction of free 3,3'-dimercaptobenzidine and isophthaloyl chloride. The polymer, although of low molecular weight, had a polymer decomposition temperature in static air fo 545° C and retained 71% of its weight after 50 hours at 700° F in static air. Meltable quinoxaline prepolymer was obtained and advanced to final polymer having a polymer decomposition temperature of 500° C in static air. Author

N65-16795# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
KINETICS OF CONDENSATION FROM THE VAPOR PHASE Quarterly Report, Aug.–Oct. 1964
Welby G. Courtney Nov. 1964 7 p ref
(Contract Nonr-4154(00))
(RMD-5515; AD-608542)

Condensation was investigated in a shock tube, using the rarefaction wave to cool the vapor-inert gas mixture. Reproducible pressure-time data were obtained with H_2O and CH_3OH, using Ar and N_2 as the inert gas. Slow condensation pseudoshocks were observed at drastic conditions. Data with CCl_4 were of limited usefulness because of the low heat of condensation. Author

N65-16856 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INVESTIGATION OF THE CHEMICAL POTENTIALS AND ACTIVITY COEFFICIENTS OF THE COMPONENTS OF BINARY SOLID SOLUTIONS
A. V. Storonkin, M. M. Shul'ts, and V. V. Korchagin *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 120–127 refs (See N65-16845 07-34)

Binary solid solutions of $K_2SO_4{\cdot}CuSO_4{\cdot}6H_2O$, $(NH_4)_2SO_4{\cdot}CuSO_4{\cdot}6H_2O$ salts at 25° C were investigated. The chemical potentials and activity coefficients of the components were calculated with the aid of the so-called third component method based on Gibbs–Duhem relations. The solid solutions appeared to exhibit features of regular ones. Author

N65-16857 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISSOCIATION CONSTANT OF METHYL ORANGE
V. V. Pal'chevskiy, M. S. Zakher'yevskiy, and T. M. Kal'varskaya *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 128–135 refs (See N65-16845 07-34)

An expression is presented for the determination of the true (thermodynamic) constant of protolytic dissociation of methyl orange as a function of the activities, concentrations, and coefficients of activities of the anion, hydrogen ion, and the amphoteric ion. How this constant differs from the apparent dissociation constant previously reported in literature is discussed. The experimental determination is made using a potentiometric–spectrophotometric method in which the electromotive force measurement is combined with the spectrophotometric determination of the concentrations of the undissociated form of the acid and its anion. Determinations were made for two series of solutions, one containing varying concentrations of NaCl, and the other, KCl; the obtained mean value of the true constant was $K_a = 3.08 \times 10^{-4}$. D.S.G.

N65-16858 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROLYTIC PRECIPITATION OF ANTIMONIUS INDIUM
V. V. Ostroumov and A. D. Styrkas *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 136–147 refs (See N65-16845 07-34)
(FTD-MT-63-251)

The possibility of the formation of semiconductive combination of InSb on a cathode from aqueous sulphate solutions was investigated. Cathode deposits present a mixture of three crystalline phases: that of antimony, indium, and indium antimonide. Subsequent warming up results in increasing the indium antimonide phase content at the expense of antimony and indium phases. Author

N65-16859 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE KINETICS OF DISSOLVING $AsSe_{1.5}$ Ge_x, $AsS_{1.5}$ Ge_x, $AsS_{2.5}$ Ge_x GLASSES IN SOLUTIONS OF CAUSTIC SODA
V. N. Timofeyeva, G. M. Orlova, G. I. Ternovaya, and G. P. Tsayun *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 148–157 refs (See N65-16845 07-34)

Investigation of kinetics of dissolution of arsenide–selenide and sulfide glasses, alloyed with germanium, in alkali solutions showed the growth of chemical stability of glasses upon increase of the contents of germanium. This regularity is explained by the appearance of a stabilizing structure of the glasses of tetrahedral units. The rate of dissolution of $AsSe_{1.5}$ Ge_x, $AsS_{1.5}$ Ge_x and $AsS_{2.5}$ Ge_x glasses in solutions of caustic soda is determined basically by the heterogeneous chemical reaction. Author

N65-16860 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOMETRIC DETERMINATION OF SMALL CONTENTS OF IRON IN THE ULTRAVIOLET REGION OF THE SPECTRUM
K. P. Stolyarov and R. Gerbach *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 158–166 refs (See N65-16845 07-34)

Ions of iron will form, with ascorbic acid, a yellow complex, possessing strong absorption in the ultraviolet region of the spectrum and are subordinated to Beer's Law in a wide range of concentrations. On the basis of this is developed a method of photocolorimetric determination of iron. Sensitivity of the method is 0.5μg/ml; with contents of iron of 5 to 10μg/ml, the error constitutes 5% to 6% of the relative errors. The

method is characterized by speed and simplicity of accomplishment and is checked on samples of alloys, oxidic ores and silicate rocks. Author

N65-16861 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICRO-METHOD OF OBTAINING 2,4-DINITROPHENYLHYDRAZONES AND THEIR IDENTIFICATION BY THE THIN LAYER CHROMATOGRAPHY METHOD
E. M. Auvinen and I. A. Favorskaya *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 167–178 refs
(See N65-16845 07-34)

The effect of various antioxidants on the thermal stability of polyacetaldehyde is considered. A series of antioxidants are presented in descending order of their effectiveness in increasing the thermal stability of polyacetaldehyde. These coincide with antioxidants arranged in descending order of their basicity. When stabilizing polyacetaldehyde, antioxidants act as inhibitors of oxidation and prevent the splitting off of acetaldehyde. Author

N65-16884*# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
CARBON DIOXIDE DISSOCIATION RATES BEHIND SHOCK WAVES
M. Steinberg Washington, NASA, Feb. 1965 29 p refs
(Contract NAS7-217)
(NASA-CR-166) OTS: HC $2.00/MF $0.50

The dissociation rates of carbon dioxide were measured at elevated temperatures behind shock waves in mixtures with argon and nitrogen. The disappearance of carbon dioxide was monitored by following the emission in the 4.3μ and 2.7μ infrared bands. Over the range from 3300° to 6000° K at total pressures of 0.5 to 1.0 atm, the bimolecular rate constant for the process

$$CO_2 + M \longrightarrow CO + O + M$$

was determined in mixtures of 0.5- to 2.0-percent carbon dioxide in argon. The corresponding rate constant for dilute mixtures of 1.0-percent carbon dioxide in nitrogen at shock temperatures from 3100° to 7700° K was also determined. The rate constant in nitrogen mixtures was independent of the total pressure from 0.5 to 5.0 atm for a series of tests at about 4800° K. Variations of mixture ratios of up to 20-percent carbon dioxide in nitrogen yielded results within the experimental spread for the dilute mixtures. Author

N65-16895 Martin Co., Baltimore, Md. RIAS Div.
COMPLEX-ION EMBRITTLEMENT OF SILVER CHLORIDE
Fourth Technical Report
A. R. C. Westwood, D. L. Goldheim and E. N. Pugh Nov. 1964 24 p refs Submitted for Publication
(Contract Nonr-4162(00))
(TR-64-21; AD-608508)

Previous studies have revealed that when polycrystalline AgCl is deformed in aqueous solutions containing complex ions of high negative charge, e.g., $AgCl_4^{3-}$, $Ag(SCN)_4^{3-}$, $Ag(S_2O_3)_3^{5-}$, etc., the fracture mode changes from ductile and transcrystalline, as in air, to brittle and intercrystalline. In this paper it is demonstrated (1) that embrittlement in chloride environments can be prevented by the presence, in solution, of such inhibitor ions as K^+, Cs^+, Zn^{2+}, Cd^{2+}, or Hg^{2+}, (2) that embrittlement can be induced by complex ions of high positive charge, and (3) that monocrystals can be embrittled providing that they contain a preexisting crack. Studies of monocrystal fracture surfaces have revealed that the fracture process is discontinuous. It is concluded that embrittlement cannot be explained on the basis of a dissolution-dependent mechanism, but is more likely to be associated with the adsorption of complex ions of high charge in the vicinity of strained surface bonds. Author

N65-16919# Tyco Labs., Inc., Waltham, Mass.
RESEARCH RELATING TO FUEL CELLS: THE OXYGEN REACTION ON PLATINUM AND GOLD IN ACID SOLUTIONS
Final Summary Report, Oct. 1, 1961–Feb. 28, 1963
A. K. M. Shamsul Huq 1 Apr. 1963 85 p refs
(Contract DA-49-186-ORD-982)
(AD-414800) OTS: $2.50

The electrode kinetics of the oxygen reaction were studied on smooth platinum and gold electrodes in acid solutions (H_2SO_4 and $HClO_4$) and at room temperature. Polarization curves were obtained both galvenostatically and at controlled potentials. The electrode coverage by adsorbed oxygen, and the extent of oxide formation were determined using chronopotentiometry and potentiostatic sweep methods. The kinetics of the electrochemical reduction and oxidation of hydrogen peroxide, an intermediate found in solution during the reduction of oxygen, were also studied. Author

N65-16942# General Precision, Inc., Little Falls, N. J. Aerospace Research Center
HIGH-TEMPERATURE RESISTANT POLYMERS Final Report, 1 Jan.–31 Oct. 1964
J. Luloff and C. Vogel 15 Nov. 1964 70 p refs
(Contract NObs-90194)
(AD-608263)

In studies of the aluminum, silicon, and titanium phthalocyanine systems, chloraluminum phthalocyanine was prepared and treated with a number of different basic reagents, notably phenyl magnesium bromide and a strong tertiary amine. New reactions were observed: (1) the Grignard reagent produced an arylated product; (2) the amine in dimethylformamide formed a reddish metallic solid which was easily hydrolyzed to hydroxylaluminum phthalocyanine hydrate, indicative of a hexacoordinated Ak-N intermediate. A high pressure facility was installed to utilize the sealed-tube reactions of silicon tetrachloride, phthalonitrile and quinoline for the improved production of dichlorosilicon phthalocyanine. This was hydrolyzed with sulfuric acid, and the prepolymer intermediate condensation product was yielded from reaction with resorcinol. Titanium phthalocyanine was isolated from reactions of titanium tetrachloride with phthalonitrile in quinoline and in chloronaphthalene. The synthesis of difunction corborane and neocarboranes was pursued in order to provide comonomers for phthalocyanine copolymers. E.P.V.

N65-16943# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering
H,H COUPLING IN DIENE-IRON CARBONYL COMPLEXES
H. S. Gutowsky and J. Jonas 28 Oct. 1964 9 p refs Submitted for Publication
(Contract Nonr-1834(1))
(TR-77; AD-608709)

The nuclear magnetic resonance (NMR) spectra of a diene-iron carbonyl complex obtained from methyl linoleate were studied to determine the effects upon the proton spectra of the nonplanarity of the H and C atoms. The terminal hydrogens (X, X'), which are nearest to and most directly affected by the bonding to iron, exhibit a large upfield shift; the resonance of the central hydrogens (A, A') appears in the normal region for olefinic protons. The two central and two terminal hydrogens give proton spectra characteristic of A_2X_2 spin systems. It was determined from an analysis of the A_2X_2 part of the proton spectra that J_{AX} and $J_{AX'}$ are of opposite sign. The

chemical shifts and coupling constants obtained were comparable with those reported for other diene-iron carbonyl complexes. The H,H coupling constants were compared with those in the heterocyclic five-membered-ring compound, thiophene. The differences between the two sets of data were quite small, most of them attributable to the diene-iron heterocycle being nonplanar whereas thiopene was planar. It is concluded that the NMR data are compatible with 1,4 addition of the Fe to the diene to form a nonplanar complex. D.S.G.

N65-16948# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering
SPIN-ECHO STUDIES OF CHEMICAL EXCHANGE. II: CLOSED FORMULAE FOR THE T_2 OF TWO SITES
Adam Allerhand and H. S. Gutowsky 29 Sep. 1964 50 p refs Submitted for Publication
(Contract Nonr- 1834(13))
(TR-76; AD-608708)

Closed expressions are derived for the decay in amplitude of successive echoes in nuclear magnetic resonance experiments for systems with two exchanging sites having different resonance frequencies, but equal transverse relaxation times in the absence of exchange. The decay is found to be the sum of two exponential terms and two pseudoexponential terms; the absolute values of the latter decay exponentially but the sign alternates from one echo to the next. For two equally populated sites, the decay simplifies to the sum of just one exponential and one pseudoexponential term. In most cases of experimental importance a single exponential term is much larger than the rest, and adequately describes the decay in echo amplitude. An iterative computer procedure uses the expressions to extract information about the system from measurements of the apparent decay time constant ($1/T_2$) as a function of 180° pulse separation (t_{cp}). In favorable cases the method yields values, not only of the lifetime between exchanges ($1/\tau$), but also of the chemical shift ($\delta\omega$) and the relaxation time in the absence of exchange ($1/T_2°$). Author

N65-16951# California Univ., Berkeley.
ELUCIDATION OF ELECTROCHEMICAL REACTIONS AND SYSTEMS Final Report, 7 Apr. 1959–30 Jun. 1964
C. W. Tobias Corona, Calif., Naval Ordnance Lab., 15 Jan. 1965 15 p refs
(Contracts N123(62738)17178; N123(62738)23531; N123 (62738)33116)
(NAVWEPS-8228; AD-455790)

Research projects were concerned with the development of reference electrodes for use in liquid ammonia, chemical dissolution of calcium in liquid ammonia thiocyanate solutions, oxidation potentials of calcium in liquid ammonia thiocyanate solutions, anodic behavior of calcium in liquid ammonia thiocyanate solutions, electrochemical behavior of the silver/silver chloride electrode in liquid ammonia, properties of solutions of calcium metal in pure liquid ammonia, dimethyl–sulfoxide as an ionizing solvent medium, a model for the theoretical analysis of flooded porous electrodes, and the effect of buoyancy forces on forced convection ionic mass transport at horizontal planar electrodes. Author

N65-16960# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
MELTING POINT TECHNIQUES FOR MILLIGRAM QUANTITIES OF VOLATILE MIXTURES
William R. Wilcox 8 Jan. 1965 12 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-281; TDR-469(9230-03)-2; AD-456488)

Two techniques for avoiding volatilization during melting point determinations are described. The first consists simply of cementing the cover glass to the slide in the microscope hot-stage technique. The second involves an electrically heated melting point block containing a slot for a sealed capillary tube containing the sample. Uniform temperature throughout the capillary is obtained by the heater design, the insulating glass plates, and lamps. Author

N65-16961# Aerospace Corp., El Segundo, Calif.
THE MULTIPLICITY OF CF_2
Julian Heicklen, Dennis Saunders, and Norman Cohen 30 Dec. 1964 12 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-284; TDR-469(5250-40)-4; AD-455993)

A transient species identified as CF_2 was produced by several methods. However, it is not known whether the CF_2 diradicals so produced are identical. The hydrocarbon analog CH_2 exists as both a singlet and a triplet, with the triplet believed to be the ground state. The evidence, based on the observed reactivity of CF_2 with C_2H_4, C_2F_4, and O_2, suggests that both states of CF_2 can be produced also, with the singlet probably being the ground state. Author

N65-16975# Bonn Univ. (West Germany). Inst. for Physical Chemistry
PHOTOCHEMICAL INVESTIGATIONS IN THE FAR ULTRAVIOLET Final Report, 1 May 1963–31 May 1964
W. E. Groth 15 Jun. 1964 151 p refs Includes 9 reprints in GERMAN
(Grant AF-AEOAR-63-94)
(AFCRL-64-654; AD-456047)

Included are reprints of published German papers and summaries of them in English. The work concerns (1) development of windowless light sources in the region of 1000 Å, (2) photochemical decomposition of NH_3, (3) photodissociations and photoionizations in the vacuum ultraviolet, (4) flash photolysis in the vacuum ultraviolet, (5) fluorescence in the vacuum ultraviolet, and (6) lifetimes of electronic states. R.L.K.

N65-16977*# Rensselaer Polytechnic Inst., Troy, N. Y.
INTERDISCIPLINARY MATERIALS RESEARCH CENTER Fifth Semiannual Progress Report, 1 Mar.–31 Aug. 1963
25 Sep. 1963 17 p
(Grant NsG-100-60)
(NASA-CR-52042) OTS: HC $1.00/MF $0.50

Activities are reported in the following areas: (1) polymer research; (2) a study of the interaction of dislocation with the discrete second-phase particles in dispersion-strengthened alloys; (3) nucleation in liquid metals; (4) ultrasonic research; (5) ultrasonic pulse interferometry; (6) excited species; (7) mechanical properties of polymers; (8) high-temperature alloys; (9) low-temperature physics; (10) ceramics research; (11) charge-transfer complexes; (12) dispersion-strengthened materials; (13) corrosion studies; (14) nuclear-magnetic-resonance research and; (15) X-ray scattering. R.T.K.

N65-17004# Naval Ordnance Lab., White Oak, Md. Non-Metallic Materials Div.
SYNTHESIS AND PYROLYSIS OF MODEL EPOXIDE COMPOUNDS AND POLYMERS
Hugh C. Anderson Jan. 1965 31 p refs
(NOLTR-64-152; AD-610390)

Six model epoxides (three crosslinked polymers, one linear polymer, and two compounds) have been synthesized and their pyrolysis characteristics investigated. The techniques of thermogravimetry, differential thermometry, and infrared spectrometry were used. Two of the most significant findings of

this work were the following: (1) Positions of the amine groups in three isomers of diaminobenzene, which were used as curing agents, have little effect on the thermal stability of the corresponding polymers made from m-phenylene diglycidyl ether. (2) Although m-phenylene diglycidyl ether/aminobenzene polymer is linear, it is just as stable thermally as crosslinked m-phenylene diglycidyl ether/m-diaminebenzene polymers. Author

N65-17005# Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMICAL OXIDATION OF SATURATED HYDROCARBONS Second Interim Technical Report, May 1–Oct. 30, 1964
A. C. Makrides et al [1964] 51 p refs
(Contract DA-44-009-AMC-410(T))
(AD-610265)

A study of the behavior under N_2 and propane gases, of smooth Pt electrodes in concentrated phosphoric acid electrolytes was carried out. The Pt electrodes slowly etch in concentrated H_3PO_4 at elevated temperatures, and although this is attenuated by annealing the electrodes, it poses a considerable experimental problem. It also probably diminishes the long-term stability of fuel cell anodes. The extent of surface oxidation of Pt increases with temperature and decreases with increase in phosphoric acid concentration. Both anodic and cathodic charging curves indicate a qualitative change of the surface of Pt electrodes with time after anodic activation. The absorption of propane on Pt from concentrated H_3PO_4 at 80° C has been studied with anodic and cathodic charging curves. Neither of these by itself is found to give a reliable estimate of the adsorbate concentration, but together they provide an insight into the character of the absorbed species. Current potential curves for the oxidation of C_3H_8 on smooth Pt, from 85% H_3PO_4, at 130° C, were also studied. Author

N65-17028# Naval Research Lab., Washington, D. C. Chemistry Div.
FUNDAMENTAL FACTORS IN DETECTING CHEMICALS AS ADSORBED FILMS Interim Report
W. A. Zisman 29 Oct. 1964 20 p refs Presented at the Conf. on Surface Effects in Detection, Washington, D. C., 29 Jun. 1964
(NRL-6168; AD-608689) OTS: $0.70

Some of the general characteristics of surfaces and adsorbed monolayers are reviewed, with emphasis on the causes of the formation of the film and the conditions leading to optimizing the adsorption, the orientation, and the packing of the molecules to be detected. The nature of the forces responsible for adsorption is discussed in relation to the reversibility of the adsorption process, and to the average lifetime of adsorption. Cooperative adsorption including surface micellization, or cluster formation, mixed films, the helpful or limiting effects due to the presence of previously adsorbed materials, and some sensitive methods of detecting and measuring the amount of adsorbed material, are given with emphasis on their application to detection of chemicals in the atmosphere. Author

N65-17062*# Cornell Univ., Ithaca, N. Y.
THE THERMAL DECOMPOSITION OF CICN
David Schofield, Wing Tsang, and S. H. Bauer [1963] 31 p refs Presented at Am. Chem. Soc. Meeting, Sep. 1963
(Grant NsG-116-61)
(NASA-CR-50672) OTS: HC $2.00/MF $0.50

The thermal decomposition of cyanogen chloride was studied in a shock tube, using specific absorption spectroscopy to follow the concentration of CN radicals as a function of time behind the shock wave. This investigation is similar to the previously studied dissociation of cyanogen, but the kinetics are much more complex because of the possibility of reactions involving the unlike radicals CN and Cl. A mechanism involving six reactions is proposed; these account for all features characterizing the observed results. Values for some ratios of rate constants have been obtained by direct analysis of the CN absorption curves. A method of trial curve fitting using a digital computer was used to deduce the absolute values of the rate constants for the important steps. Author

N65-17088# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROPHYSICAL PROPERTIES OF CERTAIN AROMATIC BETAINES
V. P. Parini, A. M. Simonov et al 28 Nov. 1964 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Khim. Nauk (Moscow), no. 3, 1963 p 446–450
(FTD-TT-64-394/1; AD-609785)

A study was made of the electrophysical properties of a number of aromatic betaines that did not have bonding between charged atoms. The dielectric permeability of the substances studied proved to be somewhat higher, lying between 2.9 and 3.9, than the majority of organic compounds. The temperature dependence of the permeability of the betaines considered is described by the usual exponential law for organic substances. Internal molecular vaiations that result in easier excitation of the electron system lead as a rule to a lowering of the "activation energy" of conductivity. D.E.W.

N65-17089# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC AND MAGNETIC PROPERTIES OF THERMALLY TREATED FERROCENE BASE POLYMERS
A. A. Dulov, A. A. Slinkin, and A. M. Rubinshteyn 6 Jan. 1965 12 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 5, no. 10, 1963 p 1441–1445
(FTD-TT-64-1365/1+2; AD-609782)

Polyamides were prepared from the *cis*- and *trans*-isomers of 4-aminocyclohexylacetic acid. Those from the *cis*-isomers are soluble in phenol, cresols, conc. sulfuric acid, hydrochloric, formic, trifluoroacetic acids and other solvents of polyamides, whereas those from the *trans*-monomers dissolve only in concentrated sulfuric acid and do not soften up to a temperature of 498° to 516°, above which they undergo degradation. No interconversion of *cis*- and *trans*-forms on polycondensation is observed. High melting, isomorphously substituted copolyamides were obtained by copolycondensation of *trans*-4-aminocyclohexylacetic acid with e-caprolactam. Author

N65-17094 Washington Univ., Seattle.
EQUILIBRIA AND PREPARATIVE METHODS FOR BORON AND SILICON COMPOUNDS Final Report
D. M. Ritter 1 Nov. 1964 6 p refs
(Grant AF-AFOSR-102-63)
(AFOSR-64-2384; AD-608755)

Research on boron compounds was completed for the methylation of tetraborane, B_4H_{10}, and dihydropentaborane, B_5H_{11}, and the isolation and characterization of hexaborane-12, B_6H_{12}. Alkyl derivatives of the less stable higher hydrides cannot be made by the rather rigorous Friedel–Crafts type procedures which serve to alkylate pentaborane-9. However, reactions with 1,2 dimethyl diborane place methyl groups on those boron atoms open to exchange. The location of the substituent in monomethydihydropentaborane was established by the proton nmr spectrum which showed attenuation of proton intensity at the particular boron atom in question. Author

N65-17125# Space Technology Labs., Inc., Redondo Beach, Calif.
ANALYSIS OF TITAN II FUEL BY THE ACETIC ANHYDRIDE METHOD. A CRITICAL REVIEW
Eugene A. Burns 7 Aug. 1963 11 p refs
(Contract AF 04(697)-1)
(STL-TR-6110-8651-RU-000; AD-452644)

The acetylation method is discussed in terms of inherent and indeterminate errors. It is recommended that a gas–liquid partition chromatographic procedure be used to analyze the fuel for water concentration. During such an analysis, the concentrations of hydrazine and UDMH are also readily obtained. D.E.W.

N65-17142# American Oil Co., Whiting, Ind.
THE RADIATION CHEMISTRY OF ACETYLENIC COMPOUNDS Technical Report, 30 Nov. 1962–31 Jul. 1964
R. E. Rondeau, L. A. Harrah (AFSC, Wright-Patterson AFB, Ohio), T. D. Nevitt, H. H. Barber, Jr., and R. Schaffer Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 30 p refs
Prepared jointly with AFSC
(Contract AF 33(616)-8247)
(AFML-TR-64-353; AD-609440)

The distribution of products from the radiolysis of butyne-2, propyne, pentyne-2, hexyne-3 and butyne-1 is given. Dimers, trimers, and tetramers, of empirical formulae C_nH_{2n}, C_nH_{2n-2} and C_nH_{2n-4}, are formed in the following relative concentration: [Dimers] >> [Trimers] >> [Tetramers]. A general mechanism on the basis of free radical reactions is invoked to account for this distribution. In addition, aromatic products are also formed. Author

N65-17211*# Gulton Industries Inc., Metuchen, N. J. Alkaline Battery Div.
INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES Second Quarterly Report, 12 Sep.–12 Dec. 1964
P. Ritterman [1964] 61 p refs
(Contract NAS3-4178)
(NASA-CR-54295) OTS: HC $3.00/MF $0.75

The effect of stand at various temperatures on the sintered plate and graphite nickel oxide electrodes was studied. Results indicate that the two types of positive electrodes differ considerably with respect to electrochemical and chemical characteristics. The investigation into the effect of overcharge on the composition of the sintered plate and nickel oxide electrode was initiated. The X-ray diffraction patterns of the positive electrode of a two-plate Ni-Cd cell, under conditions of dynamic overcharge, have many lines which cannot be attributed to NiOOH, $Ni(OH)_2$ or $Ni_2O_3 \cdot H_2O$. Author

N65-17238# Midwest Research Inst., Kansas City, Mo. Chemistry Div.
STRUCTURAL STUDIES OF INORGANIC OXIDIZERS Quarterly Report, 1 Oct.–31 Dec. 1964
R. L. Hughes et al 28 Jan. 1965 25 p refs
(Contract AF 04(611)-10215; ARPA Order 24)
(QR-2; AD-610595)

High purity samples of the oxygen and nitrogen fluorides were obtained for study as potential sources of O-F or N-F ionic species, particularly OF^+, NF_4^+, and NF_2^+. Assuming that the ions will exist in solution, a suitable solvent system for the detection of O-F or N-F ions is the oxidizer itself. Therefore, the study was concerned with the analysis of ion or radical species present in the pure liquid oxidizers, and in the liquid systems: OF_2-NF_3, O_2F_2-NF_3, and O_3F_2-NF_3. Results of ultraviolet-visible absorption spectral analyses are presented for OF_2. Equipment improvements are reported for use in infrared studies. The EPR and photolysis studies were run for OF_2 and liquid fluorine. Kinetics of the photolysis reaction are discussed, as well as the EPR results. E.P.V.

N65-17246# Union Carbide Research Inst., Tarrytown, N. Y.
FLUORINE OXIDIZERS Quarterly Technical Summary Report No. 6, 1 Sep.–1 Dec. 1964
R. H. Toeniskoetter and F. P. Gortsema [1964] 17 p refs
(Contract DA-31-124-ARO(D)-77)
(AROD-4134-1; AD-609269)

Chloryl fluoride reacts with cesium azide at −78° to liberate nitrogen, chlorine, and chlorine dioxide. The solid product appears to be CsN_2OF in admixture with other cesium compounds. A similar reaction between potassium azide and chloryl fluoride was observed. The reaction of cesium azide with chlorine trifluoride at −78° produces small amounts of chlorodifluoroamine. Consideration of the stoichiometric data obtained for this reaction suggests that a solid N-F species is produced. The reaction of chlorine trifluoride with platinum hexafluoride at −78° gives $ClF_3 \cdot PtF_5$. Fluorination of $ClF_3 \cdot PtF_5$ at 325° produced chlorine pentafluoride in 62% yield. However, there was no evidence of formation of PtF_6 during the fluorination. At 25°, neither chlorine pentafluoride nor bromine pentafluoride reacts with platinum hexafluoride. At 100°, however, bromine pentafluoride and platinum hexafluoride react to give a substance of composition close to $BrF_5 \cdot 2PtF_6$. Author

N65-17247# Lehigh Univ., Bethlehem, Pa.
SOME ASPECTS OF HETEROGENEOUS EQUILIBRIA: EQUILIBRIA BETWEEN METAL SOLUTIONS AND OXIDE SOLUTIONS IN ATMOSPHERES OF KNOWN PARTIAL PRESSURE OF OXYGEN
W. C. Hahn, Jr. Aug. 1964 15 p refs
(Contract Nonr-3762(00))
(AD-603555)

Thermodynamic considerations for systems with two metal components may be divided into those in which the free energy of formation of the oxides is markedly different and those in which it is very similar. As an example of the first case, the system Mn-Fe-O was chosen. Reactions were reviewed and a phase diagram was prepared at a partial pressure of oxygen of 10^{-14} atmospheres at a temperature of 1400° K. As an example of the second case, the system Co-Ni-O was considered. The phase diagram for this system was for a partial pressure of $10^{-6.9}$ at a temperature of 1700° K. E.E.B.

N65-17265*# Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY. I: ABSORPTION AND PHOTOIONIZATION COEFFICIENTS OF PROPYLENE AND BUTENE-1 IN THE VACUUM ULTRAVIOLET
J. A. R. Samson, F. F. Marmo, and K. Watanabe Washington, NASA, Sep. 1963 19 p refs Also published in J. Chem. Phys., v. 36, 1962
(Contract NASw-395)
(NASA-CR-18; GCA-TR-64-4-N) OTS: HC $1.00/MF $0.50

The total absorption coefficient of propylene and butene-1 vapors in the region from 1500 to 2000 Å and the photoionization coefficient in the region 1050 Å to the onset of ionization were measured by photoelectric methods. Pressures ranging from 0.04 to 0.2 mm Hg were used for the total absorption coefficient determination, and three pressures from 0.05 to 2 mm Hg were used for the photoionization absorption coefficient determination. Ionization potentials obtained directly for the two vapors agreed with previously published data. Author

N65-17297# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1964, NO. 4, OCTOBER–DECEMBER 1964

J. J. Diamond, ed. (Natl. Bur. of Standards, Washington) [1964] 60 p refs

N65-17358# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.

CRYSTALLOGRAPHIC DATA FOR SOME METAL FLUORIDES, CHLORIDES, AND OXIDES

G. D. Brunton, H. Insley, T. N. Mc Vay, and R. E. Thoma Feb. 1965 267 p refs

(Contract W-7405-ENG-26)

(ORNL-3761) OTS: $6.00

The application of X-ray and petrographic microscopic techniques has made possible the synthesis, isolation, and characterization of a large number of pure compounds. Crystallographic data for many of these compounds are contained in this report. The existence of both optical and X-ray diffraction data often permits phase identification and chemical inferences to be made which would otherwise be impossible. Author

N65-17383# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center

LOW TEMPERATURE VAPOR GROWTH STUDIES

A. Reisman 30 Jun. 1964 137 p refs

(Contract AF 19(628)-2468)

(AFCRL-64-686; AD-606797)

A room-temperature solution polishing technique for Ge and GaAs using NaOCl solutions in conjunction with a rotating wheel assembly was perfected. Conditions were defined for achieving mirror smooth surfaces of Ge by a high temperature vapor phase etching with HI. The effects of parameters such as temperature, etch rate, etchant concentration and linear gas stream velocity have been evaluated and a kinetic model to explain the observed behavior is discussed. Preliminary results with Si are also presented. In the Ge–I_2–He–H_2 vapor transport system, growth rate as a function of the variation in the H_2/He ratio was studied. A marked effect on growth rate as a result of diluting the gas stream carrying the Ge halides with a second gas stream was observed. Investigations of epitaxial germanium growth via reduction in the Ge–Cl_2–H_2 system were directed toward lowering the temperature at which smooth surfaces are obtained. Author

N65-17384# Franklin Inst., Philadelphia, Pa. Chemistry Div.

DIFFUSION IN ORGANIC CRYSTALS Quarterly Technical Report, 1 Jan.–31 Mar. 1964

P. J. Reucroft, C. H. Lee, H. K. Kevorkian, and M. M. Labes [1964] 13 p refs

(Contract DA-31-124-ARO(D)-142; ARPA Order 462)

(B2130-T-3; AD-438500)

The determination of the self-diffusion coefficient in anthracene crystals as a function of temperature and crystal orientation is described. Thermodynamic quantities associated with the diffusion process were evaluated and are discussed. The origin of an unusually long tail of diffusant concentration is considered in terms of a secondary fast diffusion process. Errors introduced by the experimental procedure are estimated. Author

N65-17389# Harvard Univ., Cambridge, Mass. Gibbs Chemical Lab.

THE OXIDATION REACTIONS OF ACETYLENE AND METHANE

G. P. Glass, G. B. Kistiakowsky, J. V. Michael, and H. Niki Aug. 1964 30 p refs Presented at the 10th Intern. Symp. on Combust.

(Contract Nonr-1866(36))

(AD-604493) OTS: $2.00

The high-temperature oxidation reactions of acetylene and methane were studied in shock waves using two techniques. A time-of-flight mass spectrometer was used to determine the concentration of reactants, intermediates and products at 50-μsec intervals throughout the reaction. In another apparatus the chemiluminescent radiation emitted by CH and C_2 and the ionization accompanying the oxidation were monitored. Author

N65-17410# Mound Lab., Miamisburg, Ohio.

MOUND LABORATORY PROGRESS REPORT FOR OCTOBER 1964

J. F. Eichelberger, G. R. Grove, and L. V. Jones 12 Feb. 1965 26 p refs

(Contract AT(33-1)-GEN-53)

(MLM-1221)

Studies in the following areas are reported: *Radioelements*—determination of the half-life of promethium 147 by calorimetry, evaluation of trioctyl phosphine oxide for separation of uranium 234 from other heavy metals, determination of decay scheme of polonium 208 and 209, and determination of polonium 210 half-life; *Alpha and Neutron Source Development*—measurement of neutron emission rates of plutonium–beryllium sources to determine effect of ingrowth of americium 241; *Isotope Separation and Purification*—studies of processes for carbon 13, neon 22, argon 36, xenon 131, and helium 3; *Analytical and Instrumentation*—least squares solution of a single exponential, counting method using quantitative determination of conversion electrons, and colorimetric method for determination of neptunium in the presence of plutonium; *Adhesives*—study of gelation time of the system 4,4'-diaminodiphenyl sulfone-Epon 828 epoxy resin-trimethoxyboroxine–acetone. D.S.G.

N65-17422# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.

DEVELOPMENT OF FIRE-RESISTANT WATER BASE HYDRAULIC FLUID Bimonthly Report, 1 Oct.–30 Nov. 1964

E. S. Blake, G. F. Deebel, and G. A. Richardson [1964] 11 p

(Contract NObs-90270)

(BMR-4; AD-608647)

Fire resistance in the nonaqueous phase is necessary in hydraulic systems operating at 5000 psi, where the aqueous phase in certain segments of the system may evaporate leaving a hazardous residue. If the water-soluble portion is to have a minimum autogenous ignition temperature (AIT) of 900° F, the pour-point depressant should possess a high AIT to compensate for any lowering from additives. Since the maximum AIT of $(RO)_x\overset{O}{\overset{\|}{P}}(OK)_{3-x}$ type of alkali phosphates appears to be < 900° F, attempts were made to raise the AIT level by molecular modification and by blending. Results of AIT determinations are presented for a number of compounds. The synthesis of several of the compounds is described, and results of hydrostatic stability tests and paint compatibility tests are discussed. D.S.G.

N65-17428# Battelle Memorial Inst., Columbus, Ohio.
PHYSICAL AND CHEMICAL PROPERTIES OF BIS(ANILINO)SILANES AND 4,4'-DIHYDROXYBIPHENYL COMPOUNDS
G. E. Cremeans and D. A. Berry Huntsville, Ala., Army Missile Command, 31 Jul. 1964 38 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-257; AD-456734)

This report in the form of data sheets, was developed from a search of the literature for bis(anilino)silanes from 1960–1964, and for 4,4'-dihydroxybiphenyl compounds from 1940–1964. The name and structure of the compound is given together with synthesis, reactions, uses, and available physical properties. References are also listed on the data sheets, and comments are made where conclusions were reached. Author

N65-17432# Humble Oil and Refining Co., Baytown, Tex.
PROTON AFFINITIES AND THE METHYL INDUCTIVE EFFECT
M. S. B. Munson Jan. 1965 18 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-9-P; AD-455749)

The relative proton affinities or basicities of some polar hydrocarbon derivatives were measured in the gas phase by observation in the source of a mass spectrometer of very rapid proton transfer reactions from a protonated molecule to a neutral molecule of a different species. For the molecules studied, replacement of hydrogen by a methyl group increased the base strength of the molecule. Agreement between relative proton affinities from proton transfer reaction and gas phase ion energetics is good. It was determined that $P(H_2O) < P(CH_3OH) < P(CH_3OCH_3)$; $P(HCHO) < P(CH_3CHO) < P(CH_3COCH_3)$; $P(CHOOH) < P(CH_3COOH)$; $P(NH_3) < P(CH_3NH_2) < P[(CH_3)_2NH] < P[(CH_3)_3N]$. Author

N65-17436# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
PHOTOIONIZATION AND ABSORPTION CROSS SECTIONS AND FLUORESCENCE OF CF_4
G. R. Cook and B. K. Ching 15 Jan. 1965 23 p refs
(Contract AF 04(695)-469)
(TDR-469(9260-01)-3; SSD-TDR-64-259-259; AD-456715)

Absorption and photoionization cross sections for CF_4 were measured in the 600 to 1000 Å region using a 1-m Seya type scanning ultraviolet monochromator with a resolution of 0.7 Å. The Hopfield continuum of He was used as the light source. The cross sections obtained show that from 600 to 1000 Å the absorption is continuous with broad maxima at 910, 780, and 660 Å and broad minima at 830 and 760 Å. The appearance potential of ions was located at 15.56 ±0.01 eV (796.7 Å). Photoionization efficiencies were computed and the results indicate that processes other than ionization, such as dissociation or excitation to higher electronic states, are appreciable. Fluorescence intensity was found to be a maximum at 905 Å. Author

N65-17483# Strathclyde Univ., Glasgow (Scotland).
PREPARATION OF NOVEL ORGANOMETALLIC COMPOUNDS OF THE TRANSITION ELEMENTS Final Report, 1 Sep. 1963–31 Aug. 1964
P. L. Paulson [1964] 24 p refs With Repr. from J. of Organometallic Chem.
(Contract DA-91-591-EUC-3101)
(AD-455123)

Particular attention was paid to compounds containing additional heteroatoms, and among these the formation of pyrazolyl manganese carbonyls was established. The behavior of the polycyclic analogs of pyrrole–indole and of carbazole was studied intensively. At least three different types of product appear to be formed from these, but complete structure elucidation has not yet proved possible for one of these three. Less successful attempts have been made to add further types of pyrrolyl complexes, and attempts to achieve substitution reactions of azaferrocene (pyrrolylcyclopentadienyliron) were renewed. Author

N65-17486# Franklin Inst., Philadelphia, Pa. Chemistry Div.
DIFFUSION IN ORGANIC CRYSTALS Quarterly Technical Report, 1 Oct.–31 Dec. 1964
P. J. Reucroft, C. H. Lee, H. K. Kevorkian, and P. Chairge [1964] 14 p refs
(Contract DA-31-124-ARO-D-142; ARPA Order 462)
(B2130-T-6; AROD-4168-3; AD-455383)

Directional freezing was used to measure segregation coefficients of the impurities anthracene and 1,2-benzanthracene containing C^{14} in 5 grams of pyrene. The distribution of impurities in a directionally frozen specimen is given by $C/C_o = k(1-g)^{k-1}$, where C_o is the initial uniform impurity concentration, C is the impurity concentration at the advancing solid front, k is the segregation coefficient, and equal to C_s/C_L, i.e., the ratio between the concentrations in solid and liquid phases. A plot of log C/C_o vs log (1-g) then determines K from the slope and intercept of the straight line obtained. Tables of segregation coefficients are included. The self-diffusion in anthracene using H^3 as tracer was investigated to determine if H^3-labeled compounds can be used as tracers for molecular diffusion studies, instead of C^{14}. Procedures were the same as for the experiment with C^{14}. The general magnitude of the diffusivity was similar to that in the case of C^{14}. It would therefore appear that H^3 can be used for labeling in diffusion studies. E.E.B.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-16352 Joint Publications Research Service, Washington, D.C.
SOME DESIGN PROBLEMS OF LARGE MIRROR RADIOTELESCOPES
L. D. Bakhrakh and K. I. Mogil'nikova *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 1–13 refs (See N65-16351 07-23) OTS: $6.00

Problems connected with the creation of large mirror radiotelescopes are examined. The requirements of radiotelescope antennas operating with low-noise receivers are analyzed. It is shown that from the point of view of these requirements, ordinary parabolic antennas are not the optimal ones. The advantages of using modified two-mirror and three-mirror antennas are shown. Author

N65-16368 Joint Publications Research Service, Washington, D.C.
ON THE EFFECT OF A FLAT DIELECTRIC SHEET ON THE DIRECTIONAL PROPERTIES OF ANTENNAS

V. A. Kaplan and L. M. Timofeyev *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 189–196 refs (See N65-16351 07-23) OTS: $6.00

Considered is the effect of flat dielectric layers of arbitrary structure (the layer being near the aperture of an antenna) on the radiation pattern of the antenna. It is demonstrated that the field in the antenna aperture depends upon the reflection properties of the sheet and the aperture, and is a function of the distance between them. Expressions are obtained that make it possible to calculate the radiation pattern of the antenna-sheet system. The results of the calculations for certain specific cases are compared with experimental data. Author

N65-16416# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SPHERICAL DIRECTIVE ARRAYS: A PRELIMINARY STUDY Report No. 1300363
Mar. 1963 20 p refs Prepared under subcontract for Little (Arthur D.), Inc., Cambridge, Mass.
(Contract NObsr-81564; Proj. Trident)
(S-7001-0307)

The performance of directive receiving arrays is analyzed for spherically symmetric arrays, transparent to sound. Results are developed for two cases, where sensitivity is limited either to a thin shell or to a complete spherical volume. In both cases, the magnitude of the sensitivity is uniform, but there is phase compensation appropriate to a plane wave traveling in a single direction. Effects of finite spacing between transducers in a point array are discussed qualitatively and briefly. Author

N65-16427*# RAND Corp., Santa Monica, Calif.
OVERSEAS TELECOMMUNICATIONS TRAFFIC AND COMMODITY TRADE
Robert L. Slighton Sep. 1963 58 p refs
(Contract NASr-21(01))
(NASA-CR-55291; RM-3817-NASA) OTS: HC $3.00/MF $0.50

It is often assumed that the growth of overseas telecommunications traffic has been (and will be) intimately connected with the growth of overseas trade. This study explores this assumption statistically by looking at the record since 1950. The method is that of regression analysis, which explores the relationship between telecommunications traffic on the one hand and trade as an "explanatory" variable on the other.
Author

N65-16428*# RAND Corp., Santa Monica, Calif.
THE MARKET FOR OVERSEAS TELECOMMUNICATIONS IN 1970
Robert L. Slighton Sep. 1963 67 p refs
(Contract NASr-21(01))
(NASA-CR-55293; RM-3831-NASA) OTS: HC $3.00/MF $0.75

This memorandum investigates the question of the size and configuration of the market for overseas telecommunications services in the year 1970. It is designed to provide background information of use to officials of the National Aeronautics and Space Administration and other Government agencies responsible for communications satellite research and development policy. Author

N65-16435*# RAND Corp., Santa Monica, Calif.
HIGH-CAPACITY SUBMARINE TELEPHONE CABLES: IMPLICATIONS FOR COMMUNICATION SATELLITE RESEARCH AND DEVELOPMENT
R. T. Nichols 30 Sep. 1963 47 p refs
(Contract NASr-21(01))
(NASA-CR-55290; RM-3877-NASA) OTS: HC $2.00/MF $0.50

The demand for channels provided by any type of communication facilities, for example, communications satellite facilities, depends among other things, on the costs of channels provided by alternative systems. The main significance of the new submarine cables is that they promise to lower the costs of conventional channels on high-volume routes, thus lessening the demand for communications satellite channels on these routes. It has often been supposed that communications satellites would be economically attractive, relative to conventional communications facilities, for long-distance, overwater, large capacity routes. The emphasis on long distance is well grounded. The reason is that the cost of satellite circuits is independent of circuit length. The emphasis on overwater is less well grounded. The cost of satellite circuits overseas is the same as the cost of satellite circuits overland; on the other hand, submarine cable circuits are probably no more expensive than landline circuits in many areas of the world, and they cost perhaps only twice as much as landline circuits in the United States. Author

N65-16515# Federal Aviation Agency, Atlantic City, N. J. Research Div.
INTELLIGIBILITY TESTS OF AUTOMATIC BROADCASTS VS. LIVE MESSAGES Final Report
Malcolm Y. Mc Cormick and Kiriako Sarlanis Oct. 1964 27 p refs
(RD-64-122)

Electromechanical devices for automatic voice transmission range from the broadcasting of ordinary tape-recorded routine information through elaborately engineered apparatus that will accept and store digitally teletype reports and, at prescribed intervals, draw on a stored vocabulary to prepare a series of voice messages for audio transmission. This paper describes an attempt to compare the intelligibility of such an electromechanical device with the intelligibility of a live communicator. Tapes were prepared with 10 standard messages on each. The tape played for eight subjects had the first five messages recorded from a live communicator and the second five, canned. The other tape heard by eight additional subjects reversed the procedure with the previously live messages now heard canned and vice versa. Overall mean scores were 70% correct for canned messages and 76% correct for live. This difference is statistically significant. It may be concluded that this preliminary model of an automatic communicator was inferior in intelligibility. Author

N65-16553*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE APPLICATION OF EXTREME-VALUE THEORY TO ERROR PROBABILITY ESTIMATION IN THE RANGER BLOCK III COMMAND DETECTOR
Edward C. Posner 15 Jan. 1965 15 p refs
(Contract NAS7-100)
(NASA-CR-60610; JPL-TR-32-705) OTS: HC $1.00/MF $0.50

Presented is an application of Gumbel's extreme-value theory to the estimation of low error probabilities in certain types of communications systems, such as the Ranger Block III Command Detector. The systems considered all involve threshold detectors in a binary system. By taking the maxima of a large number of successive independent samples, and then by taking a large number of these maxima themselves, the two parameters of the Gumbel distribution are estimated using large-sample theory. The variance of the error-probability estimate is found, as well as a confidence interval. The savings obtained by using the Gumbel method, as opposed to the simple monitoring of errors, is shown to be large. Finally, by applying a goodness-of-fit test to the voltage data of an actual Ranger Block III Command Detector, it is shown that the Gumbel distribution does indeed hold. Author

N65-16557# Michigan State Univ., East Lansing. Div. of Engineering Research
MINIMIZATION OF BACK SCATTERING OF A CYLINDER WITH A MODERATE RADIUS BY LOADING METHOD
Kun-mu Chen Dec. 1964 37 p refs Prepared for Michigan Univ.
(Contract AF 33(615)-1656)
(TR-1; AD-454928)

A theory on the minimization of the back scattering of a cylinder with a moderate radius by loading method is presented. The dimensions of the cylinder are assumed to be $\beta_0 a \leq 1$ and $\pi/4 \leq \beta_0 h \leq 2\pi$ where a and h are the radius and the half-length of the cylinder, and β_0 is the wave number. The cylinder is illuminated by a plane electromagnetic wave with its E field vector (1) parallel to and (2) perpendicular to the cylinder axis. A circumferential slot or a radial transmission line is inserted at the center of the cylinder to minimize the back scattering for case (1). A longitudinal slot is cut on the surface of the cylinder to minimize the back scattering for case (2). The surface current induced on the loaded cylinder is explicitly obtained. The back-scattered field is calculated. The optimum loading that leads to zero back scattering from a cylinder is determined. The method of designing an optimum loading is also discussed. Author

N65-16725# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR AUTOMATICALLY MAINTAINING THE LEVEL OF THE OUTPUT CAPACITY OF A TRANSMITTER
N. A. Olenev, I. M. Korolev, and S. I. Vopilkin 18 Mar. 1964 6 p Transl. into ENGLISH of Russian Patent No. 148875, (Appl. No. 697000/26), 9 Feb. 1961 p 1-2
(FTD-MT-63-275; AD-605585)

Block diagram and principle of operation is presented for this automatic device. In it, a memory circuit is applied for memorization of the level of carrier frequency from the instant of zero modulation to the instant of the appearance of the following null in modulation, and for adjustment of excitation amplitude. E.E.B.

N65-16739*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM FLIGHT EVALUATION REPORT FOR FLIGHT MODEL III-2 (RA-7)
B. Miller 30 Oct. 1964 316 p ref Prepared for JPL
(Contract NAS7-100; JPL-950137)
(NASA-CR-60646; AED-R-2473) OTS: HC $7.00/MF $1.75

The Ranger VII TV subsystem was composed of six vidicon cameras (2 full scan, 4 partial scan), the electronic equipment to control these cameras, the communications chains to transmit the acquired video information back to earth, telemetry components to monitor the operation of the functional components, a completely independent power source (batteries) for the entire TV subsystem, a structure to house and support all electronic gear, and passive-thermal-control components. The collection and evaluation of the real-time data during the Ranger VII mission is described, and the performance of the TV subsystem in relation to the collected information is evaluated. Based on the data analysis, it was concluded that the flight performance of the subsystem met or surpassed all design and mission requirements. Also described are the preflight tests performed on the subsystem, the exposure time sequence for partial-scan cameras, the least squares fit of spacecraft temperatures, and the Ranger calculation-flight discrepancy. R.L.K.

N65-16772# Miami Univ., Coral Gables, Fla. Inst. of Marine Science
RADAR HURICANE RESEARCH Final Report, 1 Sep. 1963-1 Aug. 1964
H. V. Senn and J. A. Stevens Aug. 1964 44 p refs
(Contract Cwb-10755)
(ML-64314; AD-608622)

The small-scale motion of radar hurricane echoes in Donna 1960 were studied in great detail. The echo speeds were found to vary sinusoidally with time, the oscillations exhibiting an r_s^2 phase lag with range, corresponding to a disturbance speed which varied as $1/Y_s$. The echo crossing angles experience the same oscillations, with phase lag $r_s^{1/2}$. The differences in echo motion inside and outside of spiral bands were also studied. A particular solution to the static temperature equation, which was correlated with spiral bands, was obtained for the case of the hurricane, assuming a correspondence between the spiral bands and the minimum temperatures in the hurricane. A survey of airborne hurricane reconnaissance tracking problems and accuracies is also presented, including recommendations for improving the radar position data in the future. An observation of a precipitation-free radar sea-breeze front or thin band, which became a part of a hurricane Ginny spiral band, is included in the appendix. Author

N65-16797# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF SCANNING SYSTEMS
F. Ye. Temnikov 23 Sep. 1964 158 p refs Transl. into ENGLISH of the book "Teoriya Razvertyvayushchikn Sistem" Moscow, Gos. Energ. Izd., 1963 p 1-168
(FTD-MT-64-04; AD-608599)

Described are the basic principles of active scanning, as characterized by operations of conversion of magnitude and signals; and of passive scanning, as represented by linear physical quantity changes within the limits of a time interval. The following scanning systems are analyzed: elementary, multiplied, digital, mathematical, inverse and conjugative, adaptive, and central. G.G.

N65-16807*# Radiation, Inc., Melbourne, Fla.
S-BAND TEST ANTENNA SYSTEM Instruction Manual
Feb. 1963 79 p Prepared for JPL
(Contracts NAS7-100; JPL-950268; Proj. 6620)
(NASA-CR-60675) OTS: HC $3.00/MF $0.75

This manual contains information and instructions for installation, operation, and maintenance of S-band antenna arrays for closed-loop tracking systems in the frequency ranges 2113 ±10 to 2295 ±10 Mc. This test antenna is capable of making pattern gain, and ellipticity measurements. G.G.

N65-16820# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
AN ANALYSIS OF PROPAGATION ON A TRANSMISSION LINE EMBEDDED IN A FINITE DIELECTRIC SLAB
D. Hakimoglu (M.S. Thesis-Ohio State Univ.) 31 Dec. 1964 96 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-7; AD-454856)

The fields, phase constant, and characteristic impedance of a two-conductor transmission line embedded in or printed on the surface of a thin dielectric slab are determined by means of three independent methods. The first and second techniques

are theoretical, and are based on the method of images and the theory of scattering, respectively. The third method consists of experimental measurements, and provides a check on the theoretical results. One important application of these techniques is in the investigation of a log-periodic antenna on a plane dielectric slab or a curved radome. Author

N65-16862# MITRE Corp., Bedford, Mass.
PROCEEDINGS OF THE THIRD TROPOSPHERIC REFRACTION EFFECTS MEETING. VOLUME I: RESULTS AND STATUS OF TROPOSPHERIC EFFECTS MEASUREMENT PROGRAMS
L. J. Galbiati et al Nov. 1964 240 p Meeting held at MITRE Corp., 28–30 Jul. 1964
(Contract AF 19(628)-2390)
(ESD-TDR-64-148, Vol. I; AD-609731)

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14. INSTRUMENTATION FOR LOWER TROPOSPHERIC SOUNDINGS OF REFRACTIVITY D. R. Hay p 195–205 refs (See N65-16876 07-14)

N65-16863 MITRE Corp., Bedford, Mass.
REVIEW OF ESD REFRACTION TASK
L. J. Galbiati *In its* Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. 1 Nov. 1964 p 1–8 refs (See N65-16862 07-07)

Aircraft instrumentation and the collection of valuable data were accomplished. The first two-dimensional digital atmospheric profile was applied to an operational system, and atmospheric errors were estimated. The instrumentation for determining differential phase data between 15.6 and 31.2 gc signals was developed, and the first long path field measurements were completed. The feasibility testing of the line integral refractometer to date strongly indicates its high value as a calibration tool. Author

N65-16864 Electromagnetic Research Corp., College Park, Md.
SIMULTANEOUS REFRACTIVE INDEX MEASUREMENTS BY THREE AIRCRAFT
T. S. Weaver and D. L. Ringwalt *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 9–31 (See N65-16862 07-07)

On 16 and 17 June 1964, three aircraft, equipped with refractometers, obtained simultaneous refractive index measurements in the MISTRAM area while flying a tight V-formation, and also while separated by about 20 miles. These measurements were obtained in preparation for an in order to determine the problems involved in more extensive tests planned for early August. This work was part of an atmospheric research program aimed specifically toward improving the tracking accuracy of MISTRAM. The data were not completely checked, and, consequently, the results should be considered as preliminary. Author

N65-16865 Air Force Cambridge Research Labs., Bedford, Mass. Cloud Physics Branch
SCALE AND TYPE OF ATMOSPHERIC REFRACTIVE INDEX ANOMALIES
R. M. Cunningham *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 33–41 (See N65-16862 07-07)

Clouds of the cumulus variety allow us to see various scales of refractive index anomaly. This fact permits the meteorologist skilled in mesoscale weather phenomena to contribute a nonstatistical partial answer to the radio propagation problems limiting the accuracy of radio interferometer systems. At a scale of a mile or so, the time rate of change of these cloud features is slow enough that a bias and a very low frequency noise correction could be made in the MISTRAM data in post-flight analysis. This would be done with the aid of cloud mosaics (on days with the proper cloud types) for the time of a shot and a sample of cloud-to-clear-air refractive index taken shortly before or after the same shot. A real-time correction could also be estimated from cloud observation and previous cloud-clear air ΔN measurements. A cloud climatology related to geographic features would help in locating future systems to minimize large bias and large low frequency noise errors of the above type. Author

N65-16866 Technical Operations Research, Burlington, Mass.
DIGITAL ATMOSPHERIC PROFILE GENERATION
J. H. Meyer *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 43–56 (See N65-16862 07-07)

Level-run airborne refractive index measurements versus altitude, taken at different altitudes along a flight path over the E-W leg of Mistram, are shown. The flight path extended eastward several miles over the ocean and approximately 1 to 2 miles west of the 100 K. West (KW) site. Representation of the level-run refractive index data allows one to associate discontinuities measured at a particular altitude with those measured at the other altitudes. Each level run is plotted versus time so that the distance between Mistram Central (MC) and 100 KW decreases with altitude, because the aircraft was flown at a constant indicated airspeed. At a constant indicated airspeed, true airspeed or ground speed increases with altitude and, therefore, the distance between MC and 100 KW decreases

with altitude. The cloud cross section was constructed to correspond roughly to the refractive index discontinuities from a synthesis of the level-run data and photographs taken by the C-130 and U-2 aircraft. Author

N65-16867 MITRE Corp., Bedford, Mass.
RAY-TRACINGS IN CLOUD CROSS SECTIONS FOR A LONG BASELINE INTERFEROMETER
R. K. Crane *In its* Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 57–87 (See N65-16862 07-07)

The variation of refractive index in the troposphere occurs over many scale sizes, ranging from the turbulent to the synoptic scales. Two ranges of scale sizes are considered for this analysis: those that contribute to a refractive index distribution that does not vary over the spatial extent of the cross section, and those that cause refractive index variations over distances ranging from 500 feet to the largest dimension of the cross section. The first of these scale size ranges contributes to the bias error; the second, to the cross-sectional error. The refraction-induced errors are computed using the methods of geometric optics. The scale sizes being considered imply that the changes of refractive index, over the dimensions of a wavelength, are small, and that the ray-tracing equations are valid. This approximate description of the bias profile describes the change of refractive index with height in almost the same manner as the familiar linear change in refractive index description, the maximum difference between the two approximate descriptions being 0.1N for the profiles considered. Author

N65-16868 National Bureau of Standards, Boulder, Colo.
ESD, MAUI, HAWAII, MEASUREMENTS
M. C. Thompson, Jr. *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 89–93 (See N65-16862 07-07)

Location of instrumentation on runways, Naval Air Station, Hawaii, and summary of various test conditions for which data were obtained, are presented. The installation of the 9.4-gc transmitter and receiver for the X-band, fixed end-point phase measurements at Maui, Hawaii, was started, and the first data run was performed. Measurement outline is given with sketches of horizontal short inline and long inline antenna arrangement. E.E.B.

N65-16869 MITRE Corp., Bedford, Mass.
FIELD TEST RESULTS OF THE LINE INTEGRAL REFRACTOMETER
Harold M. Richardson *In its* Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 95–114 (See N65-16862 07-07)

A transmitter and two identical receivers for measurement of water vapor were constructed and mounted in truck vans for field tests. The apparatus was operated over seven paths. The elevated path testing results indicated the presence of strongly variable fluctuations. Peak-to-peak fluctuations were determined from the first 2.8 minutes of a 40-minute test record. Data were obtained over a 6.5-mile, 4.9-degree elevated path. Fluctuations became small around sunset on May 5, 1963, and then increased for the period from midnight of May 5 to about sunrise of May 6. Fluctuations near sunset of May 6 were again relatively small before becoming alternately noisy and quiet from near midnight May 6 to almost noon of May 7. Ten power spectra were computed for the Camp Creek Bald to the Moncier path. Apparatus stability, experiments, beam switching, smoothing times, and comparison with other techniques are covered. E.E.B.

N65-16870 National Bureau of Standards, Boulder, Colo.
OPTICAL DEPOLARIZATION AND SCINTILLATION MEASUREMENTS OVER A TERRESTRIAL PATH
Jurgen R. Meyer-Arendt *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 115–123 refs (See N65-16862 07-07)

Scintillation and polarization phenomena were observed over a 25-km single terrestrial path and over a double path of twice that length. Experiments were carried out on Maui, Hawaii resulting in these conclusions: (1) There was no evidence of depolarization produced by atmospheric turbulence. Attenuation caused by haze limits the signal transmission before any depolarization becomes evident. (2) Scintillation is a major limitation to optical telecommunication. Its influence increases with distance traversed and with the degree of collimation of the light source. (3) Any receiver for optical information transmittal based on polarization must have provision for compensation of scintillation fluctuations. E.E.B.

N65-16871 National Bureau of Standards, Boulder, Colo.
FADING ON MICROWAVE LINE-OF-SIGHT PATHS
H. T. Dougherty *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 125–135 refs (See N65-16862 07-07)

Received signals for line-of-sight propagation paths tend to vary with time because of refractive index gradient variations along the propagation ray path. This effect can become severe at microwave frequencies; fading can result, reducing system reliability below an acceptable value. Experimental data indicate that frequency diversity spacing of 250 mc is inadequate for the paths described. Diversity reception by means of vertically spaced antennas will provide a substantial improvement in system performance for the fading commonly encountered over microwave line-of-sight paths for flat, maritime terrain. E.E.B.

N65-16872 MITRE Corp., Bedford, Mass.
SOME COMMENTS ON MICROWAVE LINK CHARACTERISTICS AND PROBLEMS
B. M. Hadfield *In its* Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 137–156 refs (See N65-16862 07-07)

Problems associated with setting up and maintaining a microwave link are discussed. Limiting factors, dependent on link distance, such as antenna height, propagation losses, humidity, temperature, pressure, atmospheric attenuation, and free space loss are discussed. Also, other design factors, not primarily dependent on distance, such as route survey and terminal siting, mast rigidity, reflectors, reliability, and maintenance are presented. E.E.B.

N65-16873 Stanford Univ., Calif.
FINDINGS AND RECOMMENDATIONS OF THE NATIONAL ACADEMY OF SCIENCE "PANEL ON TRACKING DATA ANALYSIS" IN THE AREA OF TROPOSPHERIC PROPAGATION AND REFRACTION
A. T. Waterman, Jr. *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 157–161 (See N65-16862 07-07)

Problems discussed are divided into three subjects: meteorology, radio, and organization. Three recommendations are made on meteorology: (1) The vertical soundings in the Cape Kennedy region should be used to develop insight into sampling error. (2) A surface network of refractive index measurement sites should be set up in the region of the two MISTRAM stations. (3) Instrumentation should be exploited for meteorologic measurements. On the subject of radio measurements, it was recommended that (1) fixed-path measurements be made

in the range area, (2) measurements be continued, so that optical sighting of locations can be compared with operation of the MISTRAM system installed in the plane, and (3) a satellite be outfitted with transponder for system calibration. Finally, the importance of the propagation problem should be reflected in an organizational setup in which there is greater centralization of control, authority, and responsibility. E.E.B.

N65-16874 Pan American World Airways, Inc., Patrick AFB, Fla.
SPACED REFRACTOMETER EXPERIMENT
C. F. Martin *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 163–171 (See N65-16862 07-07)

Refractometer background, instrument description, and the spaced-refractometer experiment were discussed. The motivation behind the experiment lies in the paucity of information on refractive index fluctuations over long periods of time at widely separated spatial points. The space–time correlation function for refractive index fluctuations is of primary interest. E.E.B.

N65-16894# United Aircraft Corp., Farmington, Conn.
CATEGORY I AND II TEST REPORT FOR TELEMETRIC DATA RECEIVING SET AN/MKR-9
Bedford, Mass., AFSC, Electron. Systems Div., 30 Sep. 1964 105 p
(Contract AF 19(628)-3357)
(ESD-TDR-64-63; AD-608505)

These tests were conducted to determine the suitability of the equipment to receive signals from an orbiting meteorological satellite and to provide a facsimile reproduction of pictures transmitted from the satellite. A special test procedure was used employing a helicopter with a special instrument package to simulate the actual satellite output. The conclusion is reached, from test results, that the AN/MKR-9 will receive and display telemetric data transmitted from an orbiting satellite. However, changes are recommended that will enhance the usefulness of the equipment and reduce existing safety hazards. Author

N65-16913# Washington State Univ., Pullman.
A RADIOMETER RECEIVER FOR SOLAR RESEARCH AT 480 MEGACYCLES
Jerry Ronald Pixton (M.S. Thesis) 1963 118 p refs
(AD-415086)

The requirements for a solar radio astronomy facility were investigated. Criteria were established for the various component parts of the radiometer receiver to be used in the solar radio astronomy facility. A first generator total power radiometer receiver was designed and constructed. Nuvistors were used in a neutrode arrangement in the rf amplifier and first if amplifier. Drift curves were obtained showing a minimum detectable noise temperature of 5.5° K and a gain fluctuation of 0.5%. A slowly varying component of the solar noise level was observed with a period of 15 to 20 minutes. Several Type 1 noise bursts were observed. The design of the second-generation switched-noise-source comparison radiometer is also included. Author

N65-16967# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
ELECTROMAGNETIC SCATTERING FROM RADIALLY INHOMOGENEOUS SPHERES AS APPLIED TO THE PROBLEM OF CLEAR ATMOSPHERE RADAR ECHOES
William A. Farone Jan. 1965 16 p refs
(ERDA-245; AD-455967)

The theory of electromagnetic scattering from radially inhomogeneous spherical region is applied to the determination of the size and order of clear atmosphere refractive fluctuations necessary to cause a perceptible radar echo. The Rayleigh–Gans approximation, ideally suited to this problem, is utilized. It is shown that atmospheric refractive index anomalies of regions on the order of 25 m or less, and with gradients of 15 N units or less, do not result in appreciable backscatter signals. A Fourier expansion of the radial refractive index dependence is suggested for the application of the exact solution of the radially inhomogeneous spherical scatterer such that an arbitrary radial dependence can be used analytically and numerically. Author

N65-17172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADAR VISIBILITY OF MARINE OBJECTS
V. P. Peresada 28 May 1964 185 p refs Transl. into ENGLISH of the book "Radiolokatsionnaya Vidimost' Morskikh Ob'ektov" Leningrad, Gos. Soyuzn. Izd. Sudostroitel'noy Prom., 1961 p 1–160
(FTD-MT-63-281; AD-606763)

Certain contemporary methods of calculating the field of secondary radiation of different bodies and surfaces are presented. A method is expounded for calculating the field of the secondary radiation of marine objects. Tables and nomographs are listed, simplifying the calculations of the distance of their radar visibility, taking into account the curvature of the earth. Experimental methods are considered for measuring the fields of the secondary radiation. This book is intended for engineers who work in the area of ship radar. It can be useful to students in advanced courses at radar institutes, and to radiophysics specialists. Author

N65-17182# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON DESIGN POSSIBILITIES FOR CREATING THE RIGID ANTENNA FOR A PARABOLIC REFLECTOR OF GREAT DIMENSIONS
P. D. Kalachev 29 Dec. 1964 18 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 12, 1963 p 49–58
(FTD-TT-64-597/1+2; AD-610352)

The design of a rigid parabolic reflector and support of diameter greater than 60 meters is considered. Deviations of the reflecting surface from the true paraboloid are the result of manufacturing errors, elastic deformation by the structure's own weight, wind load deformations, and thermal deformations caused by unequal heating of diverse parts. The minimum number of supporting points to assure the required rigidity was determined, and a suspension design was devised that lets the support points behave as if they were on an absolutely rigid body. As an example, it was found that, for a 66-meter-diameter reflector, 17 support points would be needed. The locations of these supports on the reflector are derived. Insufficient knowledge was available on wind loads on the reflector at different angles of attack and on thermal gradient deformations. The method presented leads to a compensated, almost nondeforming, reflector with a simple construction and a simple drive mechanism. D.E.W.

N65-17224# New York Univ., N. Y. Lab. for Electroscience Research
FEEDBACK COMMUNICATION SYSTEMS Final Report

J. J. Metzner, K. C. Morgan, and L. S. Schwartz 14 Nov. 1964 27 p refs
(Contract AF 19(604)-6168)
(AFCRL-64-920; AD-610092)

This report summarizes the contents of 17 scientific reports. Most of the work is included in one of three categories: (1) the theory and development of coded error-free feedback communication systems; (2) signal theory, with particular emphasis on application to feedback communications; and (3) evaluations and analyses of communication system performance. Some promising areas for future research are also given.
Author

N65-17228# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR Quarterly Progress Report, Division 4, 1 Sep.–30 Nov. 1964
12 Jan. 1965 20 p ref
(Contract AF 19(628)-500)
(ESD-TDR-64-585; AD-610021)

Developments are reported in the programs for Haystack radar signal processing instrumentation, array radars, millimeter-wavelength systems for range measurements, and microwave components. An improved dynamic range S-band tunnel diode amplifier is described. Evidence is summarized which indicates that the antenna gain for the millimeter-wavelength radar is approximately 1.3 dB lower now than it was 2 years ago. This loss in gain is due, at least in part, to an increase in the rms tolerance of the antenna surface. Two types of X-band waveguide gaskets were developed for high-power operation. They are fabricated from annealed copper for use with stainless steel flanges. Design techniques were devised for a waffled coaxial resonator to be employed as a broadbanding resonator in a wideband, X-band parametric amplifier. In a study to investigate methods of minimizing power losses and noise temperatures by appropriate treatment of the surfaces of microwave components, investigations were made of protective coatings, electroforming, and electroplating on beryllium copper coatings.
R.L.K.

N65-17254*# Alabama Univ. Research Inst., Huntsville.
ON THE WAVE PROPAGATION IN NONUNIFORM MEDIA
Hung Yuet Yee and Frederick J. Tischer (North Carolina State Coll.) [1964] 4 p refs Submitted for Publication
(Grant NsG-608)
(NASA-CR-60765) OTS: HC $1.00/MF $0.50

The scattering of plane waves by nonuniform media is currently of considerable interest. Models of this type are confined to simple cases where the permitivity ϵ is a function only of one dependent variable, and the permeability μ, is constant. Problems dealt with are actually second-order homogeneous differential equations. The method of collocation is applicable to achieve an approximate solution. This method has two advantages: there is no limitation on the variation of ϵ as long as it is a well-behaved function; good solutions can be achieved even when values of ϵ are known (by experiment) only at a sufficient number of points in space.
Author

N65-17259*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF SIMULTANEOUS BEAM FORMATION BY MEANS OF PASSIVE SCATTERING MATRICES AND UNIFORM PLANAR ANTENNA ARRAYS
R. F. Schmidt Nov. 1964 68 p refs
(NASA-TM-X-55126; X-525-64-343) OTS: HC $3.00/MF $0.75

The report discusses a general three-dimensional crystal-lattice diffraction analysis for uniform planar antenna arrays and treats, in particular, arrays whose lattice phase gradients are determined by an image plane and simultaneous beam-forming matrices composed only of coupler hybrid junctions and fixed phase shifters. A large selection of array problems is discussed by means of lattice notation and the scattering matrix concept. Spatial coordinates of antenna beam maxima and nulls are located directly by means of expressions resembling M. von Laue's crystal diffraction equations. The subject of array gain is related to the surface integral $\int E^2(\theta,\phi) \sin\theta d\theta d\phi$. Topics such as grating-lobe formation, cosine-order beams, and beams in the invisible region are treated. Weighted addition of beams is also considered with a view toward side-lobe level reduction for simultaneous beam-forming matrices, continuous beam steering, and dual-plane phased array monopulse angle tracking. An attempt was made to formulate the uniform planar phased array problem and the multiple-beam matrix concept for purposes of machine calculation. The scattering matrix notation introduced provides an organized analysis of beam-forming circuits. It is possible to convert the scattering matrix to a transfer matrix which admits chain multiplication for tandem circuits, thereby providing a method for handling circuits of greater complexity.
Author

N65-17278*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering
DOUBLE-RECEPTION DISCRETE DATA OPTIMUM CONTINUOUS SIGNAL RECOVERY
J. C. Hung 15 Jun. 1963 31 p refs Presented at the 1st Intern. Telemetering Conf., London, 23–27 Sep. 1963
(Grant NsG-351)
(NASA-CR-60781) OTS: HC $2.00/MF $0.50

This paper deals with the recovery of a continuous signal from received discrete data. A procedure for the optimum recovery of a continuous signal using two sets of discrete input data is developed, and methods for evaluating the mean square-error are shown. An example is also given to illustrate the method, and the quality, of the double-input system as compared with that of the single-input system.
Author

N65-17302# Joint Publications Research Service, Washington, D. C.
CORRELATION METHODS
B. S. Sinitsyn 25 Feb. 1965 17 p refs Transl. into ENGLISH from the book "Avtomaticheskiye Korrelyatory i Ikh Primeneniye" Novosibirsk, 1964 p 159–160, 166–175, 217–218
(JPRS-28886; TT-65-30385) OTS: $1.00

The complexity of graphic representation of speech sounds on an oscillogram was investigated by harmonic analysis to establish the simplest possible reflection of sound with high intelligibility. A considerable correlation in dependence between intensity values at different moments in time was found and used to establish correlation functions for some sounds of the English language. Intercorrelation functions were utilized to find the interconnection between oscillator signal and noise, to determine the direction of the oscillation propagation, and to localize the noise interference sources.
G.G.

N65-17332*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR ARRAYING YAGI-DISK ANTENNAS
Fred B. Beck Washington, NASA, Mar. 1965 25 p refs
(NASA-TN-D-2683) OTS: HC $1.00/MF $0.50

Discussed is the problem of arraying yagi-disk (disk-on-rod) surface-wave structures having large spacings between the elements of the array—that is, spacings greater than a wavelength at the design frequency. It is shown that symmetrical arrays having sidelobe levels less than −12 dB below the main beam of the array can be designed by using simple array theory

and the knowledge of a single-element pattern. It is significant to note that off-principal-plane sidelobes are less than those in the principal plane, and that no excessive energy is lost in spurious sidelobes. Author

N65-17349# Pennsylvania State Univ., University Park. Ordnance Research Lab.
DIGITAL CORRELATION DETECTION OF DOPPLER SHIFTED SIGNALS
C. S. Miller 17 Aug. 1964 211 p refs
(Contract NOw-63-0209-c)
(TM-220.2331-14; AD-605367)

For the digital correlator, matched filter detection requires the provision of a number of sets of doppler reference samples in compressed time. For a pure tone signal, two methods of synthesizing doppler reference samples are given, one using digital pattern generation, and the other using linearly increasing phase approximation. For a signal consisting of a pulse of white gaussian noise, doppler reference samples are synthesized by forming the sum of the carrier and modulation phase components of the signal. An experimental system consisting of 150 digital modules was constructed tc verify theoretical results; agreement was within 5%. Preliminary to the discussion of the synthesis methods, the derivation of matched filter equations is given, the ambiguity function and the doppler effect are discussed, a theorem is proved which states the doppler effect on a signal sampled at a uniform rate is equivalent to a change in the sampling rate, and a survey of digital correlator techniques is presented. D.S.G.

N65-17356# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SUB ELF GEOMAGNETIC FLUCTUATIONS. VOLUME III: OBSERVATIONS OF TRANSIENT AND BACKGROUND VLF, ELF AND SUB ELF ELECTROMAGNETIC EFFECTS PRODUCED BY HIGH ALTITUDE NUCLEAR DETONATIONS
Final Report
Lee Tepley, R. C. Wentworth, Kay G. Lambert, H. V. Prentiss, K. D. Amundsen et al 26 Dec. 1963 80 p refs
(Contract AF 19(628)-462)
(LMSC-8-08-64-1; Vol. III; AD-444557)

Two separate categories of ELF and sub-ELF effects produced by high altitude nuclear detonations are treated—electromagnetic transients produced by the explosions, and variations in background effects resulting from bomb-produced changes in the electromagnetic environment. The facilities and instrumentation used for ELF and sub-ELF are discussed. The results of geomagnetic fluctuations and electromagnetic waves produced by the detonations in the summer of 1962 are presented, as are signals from three tests conducted by the U.S.S.R. The stations all used identical equipment (induction magnetometers), thus permitting a systematic comparison of the variations in appearance of the electromagnetic transients with the location. The results concerning bomb-produced variations in background electromagnetic radiation are limited to a single event (July 9, 1962), but data are presented in a broad frequency range extending through the vlf band. R.L.K.

N65-17393# Illinois Univ., Urbana. Engineering Experiment Station
PERMANENT RECORDER FOR RADIO DIRECTION FINDING CRT BEARING DISPLAY UNITS
Charles Jack Hawley Aug. 1964 38 p refs
(Contracts Nonr-1834(02); DA-36-039-AMC-03720(E))
(RRL-251; AD-606983)

A Watson–Watt type matched twin-channel system for radio direction finding that permits permanent recordings from cathode ray tube bearing display units is described. This system employs a crossed array of four vertical antennas, and a versatile recorder that can record from any CRT display using a line or tip trace from some angle with the vertical axis. The radio receiver processes the N-S information to the vertical deflection plates of a cathode ray tube and the E-W signal to the horizontal plates resulting in a single component signal. Usually more than one signal is received due to multipath propagation resulting in an ellipse trace whose major axis is at best lined up at the desired angle with the vertical. G.G.

N65-17396# Aerospace Corp., El Segundo, Calif. Communications Dept.
SURVIVABILITY OF REDUNDANT COMMUNICATIONS SYSTEMS
S. L. Levine 24 Sep. 1964 40 p refs
(Contract AF 04(695)-269)
(TDR-269(4922)-3; BSD-TDR-64-4; AD-607116)

A computer program was developed which is capable of investigating the survivability of a class of redundant communications systems. This program provides sufficient flexibility to preclude the writing of a new program each time a variation of the problem occurs; computation time is traded for the ability to handle a greater number of situations. The systems simulated by the computer program are characterized by large numbers of communicating elements dispersed over an operations area. Each element has potentially perfect switching capabilities for relaying messages to neighboring elements. These systems are modeled by nodes, links, and zones. Nodes represent the communicating elements of the model; zones and links are used to describe the command and control organization. The computer performs a Monte Carlo analysis to obtain an estimate of the expected number of surviving missile launchers controlled by at least one command post as a function of the model parameters. Author

N65-17451*# Michigan Univ., Ann Arbor.
STUDIES OF ANTENNAS FOR SPACE VEHICLES
P. L. E. Uslenghi Washington, NASA, Mar. 1965 52 p refs
(Grant NsG-444)
(NASA-CR-159) OTS: HC $3.00/MF $0.50

Various problems associated with space vehicle microwave antennas are discussed. Analytical studies of relationships between far-field radiation patterns and near-field current distributions and surface configurations, of the effect of the vehicle on antenna performance, and of the optimization of preassigned radiation patterns are carried out. An experimental investigation on omnidirectional antennas is described. Other related problems, such as a geometrical study of dielectric lenses and high frequency scattering from coated bodies, are also considered. Author

N65-17470# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
A 420 MC SLOT ANTENNAFIER
A. G. Jennetti 15 Dec. 1964 15 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-14; AD-456347)

A 420-mc cavity-backed slot antennafier is described in which a transistor amplifier was designed to attach directly to and properly match a T-bar slot. Gain, noise figure, stability, and bandwidth are considered. Author

N65-17499# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
THE DIELECTRIC AND WIRE GRID TRANSMISSION LINE

Otho E. Kerr, Jr. Nov. 1964 13 p refs *Its* Phys. Sci. Res. Papers No. 63
(AFCRL-64-882; AD-608778)

A surface-wave antenna which has six parameters is discussed. The formulas developed permit a somewhat independent control of the phase and amplitude distribution along surface-wave and leaky-wave antennas. This design lends itself more readily to the fabrication of nonendfire surface-wave antennas that were previously designed for the same purpose. Finally, it is noted that the formulas developed can be used to design a large number of well-known wave guides and surface-wave transmission lines. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-16673# Naval Boiler and Turbine Lab., Philadelphia, Pa.
METHOD TO MAKE MULTI-POINT DISCRETE FREQUENCY ANALYSES DOWN TO ONE CYCLE PER SECOND
R. Misialek 29 Oct. 1964 24 p
(AD-451760)

A method for multipoint discrete frequency analysis down to 1 cycle per second was devised and demonstrated. Complex signals, comprised of a ramp and two sinusoids synthesizing vibration signals with frequency component separation of 1 cps and 2 cps, were tape recorded. Time expansion with accompanying frequency multiplication was achieved using tape speedup. The resultant tape playback signals were studied by various analyzers. Results show the method is satisfactory when used in conjunction with constant bandwidth analyzers, and when applied in the region of machinery rotationals.
Author

N65-16759*# Pratt and Whitney Aircraft, East Hartford, Conn.
COMPUTER PROGRAM FOR DESIGNING SHELL-AND-TUBE LIQUID METAL CONDENSERS (MANUAL)
H. L. Ornstein and S. S. Wyde Jan. 1965 91 p
(Contract NAS3-2335)
(NASA-CR-54252; PWA-2370) OTS: HC $3.00/MF $0.75

The overall philosophy and logic of the computer program is presented, and the following items are covered in detail: (1) input format and instructions, (2) printout format, (3) computer flow diagram, and (4) list of computer statements. For a particular set of flows, thermodynamic end states, and cross-sectional geometries, the program generates the following: (1) tube length, (2) core weight and volume, (3) pressure losses of both fluids, and (4) temperature profiles of both fluids along the length of the condenser. The program is limited to the following: (1) condensing fluid flow inside of tubes and coolant flow along the outside of tubes, (2) single-pass counterflow cooling arrangement, (3) diameters of tubes and shell either varying or constant with length, but not varying shell diameter with constant tube diameter, and (4) equilateral triangular tube pattern. This program is coded in Fortran II.
Author

N65-16788# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
A COMPUTER PROGRAM FOR THE ANALYSIS OF ILLUMINATION PATTERNS RESULTING FROM N SEPARATED FLARES
Charles M. Starrett Dec. 1964 32 p
(PA-TM-1458; AD-452365)

Analytical and numerical formulas which make possible the determination of the Ground Illumination Contour for an arbitrary number of flares in a straight line are derived in this report. The machine program (GRILCO), written in FORTRAN for the IBM 709, which generates a graph of the actual Ground Illumination Contour and/or gives a printed listing of the coordinates and other information necessary to produce this contour is also presented.
Author

N65-16905# Argonne National Lab., Ill. Applied Mathematics Div.
APPLIED MATHEMATICS DIVISION SUMMARY REPORT, 1 July 1963–30 June 1964
William F. Miller [1964] 99 p refs
(Contract W-31-109-ENG-38)
(ANL-6952) OTS: $4.00

Computer programs are summarized, with each identified by job number, title, requestor, consultant, programer, description of program, and code indicating the machine for which it was prepared. The status of library information, references, and the mathematical classification of each program are also given.
E.E.B.

N65-16927*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RADIOSONDE AUTOMATIC DATA PROCESSING SYSTEM
Robert E. Turner and Richard A. Jendrek 22 Dec. 1964 27 p refs
(NASA-TM-X-53186) OTS: HC $2.00/MF $0.50

The method of reliably identifying the time-shared temperature, humidity, and reference frequency information from a modified AN/AMQ-9 Radiosonde is described. That automatic reduction of radiosonde data by the described method possesses operational capabilities, is demonstrated by more than 300 balloonborne meteorological soundings from September 1963 to November 1964.
Author

N65-16928# System Development Corp., Santa Monica, Calif.
COMMAND RESEARCH LABORATORY: INTRODUCTION TO THE TIME-SHARING SYSTEM
Jules I. Schwartz 14 Sep. 1964 25 p refs
(SP-1722/000/00; AD-451862)

A time-sharing system was developed to permit parallel running of computer problems of the on-line, man–machine, interactive variety. In this system, all programs requested by the users are stored on an assigned section of the drum until the user quits. A program is given one quantum of time to operate, which represents the maximum time for one operating cycle. The program's turn ends when it requests an input–output transfer, when the quantum of time ends, or when an error condition arises. When the turn ends, the controlling program entitled "Executive System," determines if another program is ready to operate and, if so, brings it to the core. The "Executive System" resides permanently in 16000 registers of core and has the following major functions. (1) It takes required action to all computer interrupts. (2) It interprets inputs and commands from teletypes and typewriters. (3) It allocates both core and peripheral storage, performs all input–output, schedules the running of objects programs, and performs a number of on-line debugging services.
D.S.G.

N65-16981*# General Electric Co., Valley Forge, Pa.
PROGRAM DESCRIPTION AND OPERATING INSTRUCTIONS FOR AN "OFF-LINE" COMPUTER PROGRAM FOR NIMBUS INTEGRATION AND TEST
H. G. Klose and E. S. Pelling 23 Apr. 1963 97 p *Its* Doc.-63-SD-596
(NASA-CR-52864) OTS: HC $3.00/MF $0.75

The A-Stored 160-A computer program is described. This program, which is really four programs, or modules, is designed to provide spacecraft performance data for a more detailed analysis of system and subsystem status between tests or simulated orbits. J.E.T.

N65-17006# Mitre Corp., Bedford, Mass.
PROGRAM STRUCTURE FOR MILITARY REAL-TIME SYSTEMS
James H. Burrows Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1965 28 p
(Contract AF 19(628)-2390)
(ESD-TDR-64-161; SR-122; AD-610318)

This report describes the program design and accompanying tools required to fabricate an initial operational program that is subject to change through use and as a result of changes in the environment of the system. Major design decisions are shown to have little relation to the programing language that is chosen for the statement of the logical data transformation to be implemented by the final program. The actual coding required for performing the logical transformations turns out to be a relatively small part of the overall design job. The choice of the programing language to be used is just an initial decision in the process of selecting adequate tools for assisting the production and modification of real-time programs. Author

N65-17010# Raytheon Co., Alexandria, Va. Space and Information Systems Div.
A COMPREHENSIVE ZENITH CAMERA DATA REDUCTION PROGRAM FOR THE CDC 1604 B COMPUTER IN FORTRAN LANGUAGE Final Report, Apr.–Jun. 1964
E. L. Merritt, Howard Garcia, and Herbert Chapple Griffiss AFB, N.Y., RADC, Dec. 1964 52 p refs
(Contract AF 30(602)-3338)
(RADC-TDR-64-391, Vol. 1; AD-610188)

A data reduction program for the zenith camera is written in FORTRAN language compatible to the CDC 1604B computer. The reduction includes the solution for the mean and apparent places of updated stars, the tangential solution, and the error analysis. The tangential solution eliminates the effects of radial lens distortion and atmospheric refraction. Flow diagrams, FORTRAN source program, data formats, and the load sequence are presented. An example of the data formats for a sample computation is included in the report. Author

N65-17082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ELECTRONIC INTERLOCUTOR—AND THE MACHINE SAID IN RESPONSE
Ye. Saparina 1 Dec. 1964 26 p Transl. into ENGLISH from Znanie Sila (Moscow), no. 10, 1962 p 29–32
(FTD-TT-64-71/1+2; AD-609784)

A conversation is presented between a man and a machine. The general requirements for a teachable machine capable of accepting, recognizing, and discriminating spoken inputs are discussed. Different types of analog models and spectra of speech are presented. Some neuropsychiatric case studies of persons suffering from perception, discrimination, and reproduction malfunctions (in the cerebral cortex) are discussed in relation to cybernetics of an electronic interlocutor. It is stated that cybernetic techniques are not presently available for successful production of such a machine. E.P.V.

N65-17178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF SEEKING WORDS IN A DICTIONARY
K. I. Kurbakov and R. V. Smirov 23 Dec. 1964 5 p Transl. into ENGLISH from Soviet Patent no. 155670 (Appl. no. 776076/26-24, 28 Apr. 1962) 2 p
(FTD-TT-64-481/1; AD-610340)

A method for seeking words in an electronic dictionary is described that utilizes information parts referring to the source word. Address substitutions are produced by comparing additional source information and sought words up to the moment of comparison of the additional attributes. G.G.

N65-17180# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF CONSTRUCTING PNEUMATIC COMPUTERS OF CONTINUOUS ACTION AND WAYS OF UTILIZING THEM
N. D. Lanin and V. I. Pashintseva 9 Jan. 1965 17 p refs Transl. into ENGLISH from the publ. "Nauchno-Tekhnicheskoye Obshchestvo Priborostroitel'noy Promyshlennosti. Primeneniye Vychislitel'noy Tekhniki Dlya Avtomatizatsii Proizvodstv Trudy Soveshchaniya, Provedennogo v Oktyabre 1959" Moscow, Mashgiz, 1961 p 445–457
(FTD-TT-64-498/1+2; AD-610320)

Pneumatic computing device construction problems are discussed, and a computing machine of continuous action is described. The basic elements of integration, differentiation, addition, and coefficients are discussed. E.E.B.

N65-17190# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CONSTRUCTION OF HIGH SPEED CONTROL COMPUTERS
I. N. Bukreyev 22 Dec. 1964 12 p Transl. into ENGLISH from the publ. "Nauchno-Tekhnicheskoye Obshchestvo, Priborostroitel'noy Promyshlennosti, Primeneniye Vychislitel'noy Tekhniki Dlya Avtomatizatsii Proizvodstva Trudy Soveshchaniya, Provedennogo v Oktyabre 1959" Moscow, Mashgiz, 1961 p 419–426
(FDT-TT-64-755/1+2; AD-610345)

The advantages of the arithmetical machine over the differential analyzer are presented. The basic advantage is that the sequence, in the carrying out of the operations, is determined by the program which can depict a linear or nonlinear dependence and make the machine isomorphic to any dynamic system. This property makes it possible to use it in a continuous system of automatic control instead of a great collection of functional assemblies and units. The problem of constructing the basic part of the high-speed arithmetical device, the summator, is discussed. E.E.B.

N65-17201# Honeywell, Inc., St. Paul, Minn.
TRAINABLE FLIGHT CONTROL SYSTEM INVESTIGATION Final Report, 1 May 1963–30 Apr. 1964
Fred B. Smith, Jr., John F. L. Lee, Arthur R. Butz, and Gregory J. Prom Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jul. 1964 189 p refs
(Contract AF 33(657)-11316)
(FDL-TDR-64-89; AD-607441)

Adaptive control systems were synthesized which adapted to general changes in plant dynamics with a control computer of modest capabilities. Explicit vehicle identification was not required, and an on-line memory capability was used to store the results of off-line computations. The fixed transformation adaptive controller was able to realize linear or nonlinear control laws. Substantial progress toward developing a better training method was accomplished by linear programing techniques. The use of parity logic to connect a layer of threshold logic was useful in realizing fixed transformations of greater mapping capability than could be achieved by a single threshold element. Cost data were attractive. R.L.K.

N65-17227# Mitre Corp., Bedford, Mass.
SYSTEM DESIGN AND ENGINEERING FOR REAL-TIME MILITARY DATA PROCESSING SYSTEMS
D. R. Israel Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1965 68 p
(Contract AF 19(628)-2390)
(ESD-TDR-64-168; SR-124; AD-610392)

The key problems and considerations arising in the design, engineering, and implementation of military systems in which real-time data processing plays a central role are treated. The principal distinguishing characteristics of these command and control systems are summarized. Organizational matters relating to responsibilities, operational inputs, and procurement aspects are described in the context of the overall system acquisition process. Initial considerations which should guide the overall design are discussed, including such outstanding design problems as the proper matching of man–machine capabilities and the provision of adequate capacity and flexibility for change and growth. Important aspects of hardware, software, and testware design are also detailed. Author

N65-17234# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering
AN EXECUTIVE PROGRAM FOR MULTIPLE CONSOLES Interim Technical Report
N. S. Prywes and D. H. Miller 25 Mar. 1964 30 p ref
(Contract Nonr-551(40))
(Rept.-64-13; AD-600979)

A revision of the Naval Aviation Supply Office IBM 1410 data processing system is specified (1) to permit the computer to be controlled through the use of a set of remote input–output stations with the same accuracy as that attained by controlling it through the main console, and (2) to require the presentation of all requests in a nine-part flexible input format. The hardware consists of an IBM 1410 central computer with 16 servos, a card read-punch, a console, six IBM 1014 remotes, and two IBM 1301 disks. R.L.K.

N65-17241# Massachusetts Inst. of Tech., Cambridge.
THE OPS-1 MANUAL
Martin Greenberger May 1964 59 p refs
(Contract Nonr-4102(01); Proj. Mac)
(MAC-TR-8; AD-604681)

The recent attainment and continuing development of personally accessible computer facilities opened another chapter in the use of machines by man. A number of current research efforts, including Project MAC, are designing new conceptual systems to adapt the emerging technology to a wide range of human activity. Activities relating to management are the concern of a trial system at Project MAC, called OPS-1. The OPS-1 system and the experiment that launched it are described in this manual. Author

N65-17284*# Space Technology Labs., Inc., Los Angeles. Data Analysis Dept.
PROCESSING AND PRESENTATION OF DIGITAL DATA FROM OUTER SPACE. II: EXPLORER VI "PADDLE-WHEEL" SATELLITE
J. M. Seehof, K. H. Redner, and D. W. Roberts [1963] 16 p ref
(NASA-CR-51035) OTS: HC $1.00/MF $0.50

Prior to launch, a set of simulated scientific data for 16 sequential frames was prepared. These data were then made repetitive to simulate a 10-minute transmission from the Explorer VI Satellite, and were perturbed with error rates varying from 1/15 to 1/100 in a random manner. In addition, bit slippages of from one to three bits were inserted every ten frames or so in a random manner. Such data were used to successfully check out the program and to yield information relating the cost of processing these data (one-half hour processing per hour of transmission at a 64 bit rate per second). As a result of this preflight simulation study, the first set of digital data telemetered from Explorer VI was reduced in minimal time and delivered to operations personnel for analysis and necessary action. I.v.L.

N65-17366# Auerbach Corp., Philadelphia, Pa.
INTERVIEW GUIDE HANDBOOK
8 May 1964 53 p
(Contract ARPA SD-219)
(AD-601259)

To determine how scientific and technical information is acquired and used by research and development personnel, interviews of 1500 subjects are planned in which questions relating to information wanted, information used, tasks for which it was used, and source are asked. Guidelines are presented for setting up and conducting the interviews, and for procedures such as the introductory speech, obtaining the respondent profile, analyzing task information, and determining respondent problems. Data from the interview are to be recorded in both quantitative and narrative form to permit search for new patterns of information acquisition and usage. D.S.G.

N65-17425# Northwestern Univ., Evanston, Ill.
CLASSIFICATORY AND REGIONAL ANALYSIS BY DISCRIMINANT ITERATIONS
Emilio Casetti [1963] 99 p refs
(Contract Nonr-1228(26))
(TR-12; AD-608893)

A new tool for evaluating classifications based upon discriminant procedures usually employed for extending classifications to new objects, is proposed. The discussion provides an opportunity for analyzing the links between creation ex novo, extension, and evaluation of classifications. The structure of classifications is investigated by identifying cores of classifications and limiting classifications. The effect of random factors on classifications is treated by restricting the bases of classifications to systematic influences rather than using the classical probabilistic framework. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-16342 International Business Machines Corp., Yorktown Heights, N.Y.
IBM TECHNICAL DISCLOSURE BULLETIN, VOLUME 7, NO. 6
G. E. Moore et al Nov. 1964 150 p

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N65-16409# General Precision, Inc., Little Falls, N. J. Kearfott Div.
VELOCITY SENSING SWITCH Final Engineering Report
William C. Albert 28 Sep. 1964 18 p
(Contract DA-30-069-AMC-418(A))
(M22033-7; AD-608878)

The device is basically an unconstrained (along its sensing axis), viscous-damped proof mass which integrates an input acceleration and closes a switch when a preset velocity is reached. Important design considerations covered are envelope, materials used, design of automatic damping control, velocity adjustment, contacts, and latch mechanism. Procedures and problems encountered during assembly and testing are discussed, along with calibration methods. Design goals for future devices, based on experience gained on this project, are also discussed. Author

N65-16410# Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
INTEGRATED CIRCUIT STUDY Final Report, 1 Jun. 1963–1 Jul. 1964
Aug. 1964 132 p
(Contract NObsr-89341)
(PX-3266; AD-605432)

The possibility of replacing state-of-the-art multichip circuits with monolithic circuits was investigated, by comparing multichip units with specially created monolithic circuits, equivalent to combinations of the multichip circuits. One unit of each of ten types was opened for structural analysis. Similarly each unit which failed catastrophically during the various stresses was opened and the cause of failure was determined. Stresses included a series of incoming tests to establish a basis of comparison, operating life tests, a series of environmental stresses, and performance testing. One of the monolithic DTL circuits approached the standard required for multichip circuits. Analysis revealed that most failures were associated with wire bonds, and that the larger number of leads in multichip circuits increased the chances of failure in these units. Author

N65-16525# Weapons Research Establishment (Australia).
THE CUTOFF WAVELENGTH OF THE TE_{10} MODE IN RIDGED RECTANGULAR WAVEGUIDE OF ANY ASPECT RATIO
J. R. Pyle Oct. 1964 25 p refs
(WRE-TN-PAD-92)

The cutoff wavelengths of single- or double-ridged rectangular waveguide of any aspect ratio were computed, allowing for the discontinuity susceptance of the ridge and the proximity of the ridge to the sidewall of the waveguide. The first-order correction curves given by Hopfer were replaced by accurate correction curves which show quite definitely that the correction or F factor is itself a function of the b/a ratio. Author

N65-16574# General Electric Co., Syracuse, N. Y. Electronics Lab.
MATRIX CONTROLLED DISPLAY DEVICE Third Interim Development Report, 15 Dec. 1963–15 Mar. 1964
A. P. Orimenko and K. W. Laendle 24 Mar. 1964 39 p
(Contract NObsr-89334)
(AD-433502)

Progress is described in the development of a feasibility model of a large screen, matrix controlled display device using in-air surface deformation recording and Total Internal Reflection Prism (TIRP) projection techniques. The results of in-air recording tests on a deformable medium of thermoplastic and oil are discussed. It is shown that writing rates of 100 microseconds per line are achievable with in-air thermoplastic recording. Problems in thermoplastic development and reusability are discussed. It is shown that in-air recording can be controlled by an X-Y matrix. A modification to the TIRP optical system, required to provide individual display elements with oil recording, is discussed. Author

N65-16640# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
ADVANCED FABRICATION PROCESSES FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report, 2 Jun.–2 Sep. 1964
W. T. Matzen 19 Nov. 1964 74 p refs
(Contract AF 33(615)-1242)
(IER-03-64-74; AD-608707) OTS: $3.00

Studies of the silicon adaptive element were continued, and primary effort was directed toward the development of transparent conductive contacts. A study of the Seebeck effect for application as a thermal sensor in thermal-electrical functional electronic blocks was initiated. Theoretical and experimental analyses are included. Design of the temperature-stabilized substrate was completed, and the devices are in process. Development of the thermal-feedback video amplifier was completed, and performance data are presented. Investigations of a resistance-capacitance active filter for use as a band-bass amplifier are continuing. Detailed design criteria are presented, along with experimental results for both breadboard and integrated versions of the amplifier. Author

N65-16655# ITT Corp., Easton, Pa. Electron Tube Div.
PRODUCTION ENGINEERING MEASURE FOR A PHASE II SUPER POWER HYDROGEN THYRATRON TUBE Ninth Quarterly Progress Report, 7 Mar.–6 Jun. 1964
H. E. Krefft [1964] 13 p
(Contract DA-36-039-SC-85985)
(Rept.-9; AD-608555) OTS: $1.00

Delivery and installation of the test set were completed. Although a successful test run of 48-hours duration at full power had been made at the previous location, operation at the new location was not possible at once owing to numerous imperfections in both the interlock system and some components in the set. These conditions were corrected as they appeared, but this work was not completely terminated by the end of the quarter. Therefore, none of the scheduled tests was carried out. Author

N65-16661# Harry Diamond Labs., Washington, D. C.
DIRECT-COUPLED MICROPOWER TRANSISTORIZED PREAMPLIFIER
B. P. Zanin 18 Aug. 1964 21 p refs
(TM-64-2; AD-452441)

A micropower four-stage, direct-coupled, low-frequency preamplifier was designed and tested for high-stability operation over a $-40°$ to $+60°$ C temperature range. The unit employs unique ac and dc feedback circuitry and diodes to provide interstage coupling. Test results obtained with five of these units indicate the feasibility of the design concept. Author

N65-16715# General Electric Co., Schenectady, N. Y. Tube Dept.
SUPERPOWER MILLIMETER WAVE TUBE Third Quarterly Progress Report, 15 Apr.–14 Jul. 1964

H. L. Thal and R. G. Lock [1964] 39 p
(Contract DA-36-039-AMC-03409(E))
(Rept.-12; AD-452609)

The computer program used to obtain the locked response for an array of magnetrons was modified so that it can be used to determine the self-oscillating (zero drive power) modes of the array. The program was also modified to take into account the effect of the length of transmission line between each magnetron and the T junction which couples it to the array. A three-tube array was designed. The first and second stages were tested separately, and the second and third stages were tested as a unit. The computed results for the driven response and an oscillating mode of the two-tube unit agreed with the experimental results. A five-tube array was also designed. Some design criteria and the computed performance are presented. The first AX9 rising-sun prototype stage has been exhausted. Testing of this tube is now underway. Author

N65-16764# General Electric Co., Syracuse, N. Y. Television Receiver Dept.
PERFORMANCE AND LIFE EVALUATION OF A SEALED LIGHT VALVE TUBE Final Summary Technical Report, 19 Jun. 1963–19 Jun. 1964
Edmund F. Schilling Sep. 1964 37 p
(Contract NObsr-89400)
(AD-608639) OTS: $2.00

It was demonstrated that a light-valve tube could be packaged in conventional cathode-ray-tube form to extend the life of light-valve projectors and to provide for replaceability and maintenance-free operation. The tubes fabricated, which included a disk transport system, a tape transport system, and a monochrome schlieren optical system, were suitable for 500-hour operation. Improvements in components and process control would allow for tube performance in excess of 2000 hours. The end of the tube's life is subjective, and is primarily due to picture deterioration. R.L.K.

N65-16783# Texas Instruments, Inc., Dallas.
LOW NOISE L-BAND TRANSISTOR Quarterly Progress Report No. 1, 15 May–15 Aug. 1964
K. B. Landress, Roger R. Webster, and R. L. Petritz [1964] 18 p
(Contract DA-28-043-AMC-00119(E))
(TI-03-64-62; AD-452451)

A planar germanium device with the required characteristics as determined by analysis of Nielson's noise equations was designed and constructed. The major emphasis of work was devoted toward evaluating L-78 geometric patterns. Minor changes in the fabrication procedure for the L-78 were instituted to improve the yield of the device. Analysis of device parameters was conducted. Techniques to increase intrinsic f_T and reduce emitter transit time were studied. Electrical measurement of the parameters of fabricated devices showed a typical value of r_b' of 30 ohms. Excellent yields are presently being obtained on planar devices having a measured f_T of 1 Gc and an r_b' of approximately 30 ohms. The f_T on the planar device is not as good as that obtained on advanced mesa devices; however, it is believed that there are no inherent limitations on f_T for a planar construction. Author

N65-16796# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ULTRASONIC EMITTERS WITH QUARTZ PIEZOELEMENTS OF Y-SECTION
A. P. Sviridov, Ye. A. Korepin et al 19 Nov. 1964 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), no. 1, 1959 p 34–37
(FTD-TT-63-1226/1+2; AD-608604)

When investigating quartz piezoelements of various cuts, it was discovered that more intensive oscillations were obtainable from the y-cut than from the x-cut. These phenomena are discussed, and the conclusion is reached that change to the y-cut instead of the x-cut piezoelements reduces the consumption of costly quartz and provides emitters with much higher electroacoustic efficiency. Emitters with y-type piezoelements are finding effective application in ultrasonic washing and cleaning of clock and optical components. E.E.B.

N65-16805*# Lockheed-Georgia Co., Marietta. Georgia Nuclear Labs.
COMPONENTS IRRADIATION TEST NO. 1—TRANSISTORS AND SCR'S
21 Feb. 1964 115 p
(Contract NAS8-5332)
(NASA-CR-56575; ER-6785) OTS: HC $4.00/MF $0.75

Four types of transistors and one type silicon controlled rectifier (SCR) were subjected to a radiation exposure of about 2.9×10^{14} n/cm^2 at a constant temperature of 100° F. At the end of the irradiation period all SCR specimens had failed, and the current gain of all transistor specimens had decreased to less than 35% of their original value. Analysis of the radiation-induced failure distribution of the transistors indicates that significant safety factors must be considered to assure their reliable operation in electronic circuits exposed to nuclear radiations. The I_{cbo} measurements performed on all specimens during the irradiation showed that this parameter did not increase above the manufacturer's specification, until the current gain of the transistor had degradated to an unusable value. For practical circuit applications normal bias point stabilization techniques should be sufficient to stabilize I_{cbo}. Five of the fifteen irradiated SCR specimens exhibited discontinuities, which were apparently radiation induced at an exposure of 1.09×10^8 n/cm^2. The other SCR specimens were grouped and operated into the order of 10^{12} n/cm^2 without serious degradation. R.L.K.

N65-16823# Watkins-Johnson Co., Palo Alto, Calif. Tube Research and Development Dept.
STUDY OF DISTORTION IN KLYSTRONS AND TRAVELING-WAVE TUBES Sixth Quarterly Progress Report, 1 Sep.–30 Nov., 1964
William Kunz [1964] 28 p
(Contract DA-36-039-AMC-02321(E))
(Rept.-6; AD-456544)

Experimental results are given for a low voltage, high gain version of the WJ-237, a PPM focused 2.5 watt L-band traveling-wave tube. Experimental results include balanced two-tone intermodulation tests, and the intermodulation characteristics are related to versions previously examined. Author

N65-16914 General Electric Co., Owensboro, Ky. Tube Dept.
7486 CERAMIC TRIODE, PRODUCTION ENGINEERING MEASURE Final Report, 19 Jun. 1962–19 May 1964
J. D. Marshall [1964] 209 p
(Contract DA-36-039-SC-86738)
(AD-608401) OTS: $6.00

A production capability for producing 100 tubes per day using oil-free vacuum equipment was established; the advantage of using such equipment is the elimination of possible hydrocarbon residues. An improved test specification was established that reflected the increases in tube ratings, such as allowable plate dissipation, maximum cathode current, and grid current limit. An rf-oscillator life test and amplifier performance tests were also established. The use of tungsten–rhenium heater wire was shown to be effective in providing improved heater-current

stability. Darkening the surface of the heater insulation was intended to serve the same purpose, but an increase in losses, due to nonuniformity of darkening, was observed. D.S.G.

N65-16955# Westinghouse Electric Corp., Baltimore, Md. Applied Research Lab:
3.0 MILLIMETER WAVELENGTH DUPLEXER Final Report, 15 Jul. 1963–30 Sep. 1964
Stafford D. Schreyer 1 Oct. 1964 12 p
(Contract DA-36-039-SC-89223)
(AD-456542)

The 3.0-millimeter crystal protector tube was designed as a multielement device having three active elements. The high power stage consisted of a high Q window alone, while the intermediate and low power stages contained cone-inductive pin resonant structures. The low power stage differed from the intermediate in that it also included a side arm keep-alive electrode enclosed in an inductive block. One such tube was completed and both bandwidth characteristics (VSWR and insertion loss) over the 91- to 96-gc band and high power characteristics were measured, and low leakage power was demonstrated. The data indicated the need for certain design changes. Author

N65-16973# Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center
THE EFFECT OF NUCLEAR RADIATION ON ELECTRONIC COMPONENTS, INCLUDING SEMICONDUCTORS
R. K. Thatcher, D. J. Hamman, W. E. Chapin, C. L. Hanks, and E. N. Wyler 1 Oct. 1964 236 p refs
(Contract AF 33(615)-1124)
(REIC-36; AD-454707)

Information is presented that covers the state-of-the-art of knowledge on the effects of nuclear radiation on basic electronic parts. It represents a summary of information accumulated within the past three years plus information previously reported. This report presents component results that are grouped as to family within each component class type. These results are intended to provide a basis for judging the merits of the parts when they are used in circuitry that is exposed to a radiation environment. Some of the data included can be considered as design oriented, to the extent that they indicate radiation levels at which the parts would be expected to perform satisfactorily. Author

N65-16999# Microwave Associates, Inc., Burlington, Mass.
K_A-BAND CRYSTAL PROTECTOR Final Progress Report, 15 Mar. 1963–15 Sep. 1964
Paul Basken [1964] 101 p
(Contract DA-36-039-AMC-00157(E))
(Rept.-6; AD-451902)

The development effort leading to a long-life, broadband crystal protector of operation in K_A band is treated in this report. The topics covered include the design and evaluation of the various crystal protector configurations. A broadband four-element gas TR tube, a two-element gas pre-TR tube, and a PIN switch were developed. The final version of the crystal protector is shown to consist of a gas TR–PIN switch combination. Life test data and evaluation are also included. An overall evaluation of the final-design crystal protector is given. Author

N65-17001# Michigan Univ., Ann Arbor. Electron Physics Lab.
APPLIED RESEARCH IN MICROWAVE AND QUANTUM ELECTRONICS Interim Scientific Report No. 2, Jul. 1–Dec. 1, 1964
J. E. Adair, J. E. Boers, G. I. Haddad, G. T. Konrad, R. J. Lomax et al Dec. 1964 37 p refs
(Contract AF 33(615)-1553)
(Rept.-06349-7-S; AD-454788)

The nonlinear equations for solution of two-dimensional nonlinear beam-plasma interactions were programed on a digital computer. The difficulties encountered in operating the millimeter-wave plasma oscillator are described. Low frequency oscillations and film deposition along the dielectric tube resonator present problems. Recommendations for possible elimination of these undesirable effects are given. A different method for generating the plasma discharge necessary in the beam-plasma amplifier is under investigation. A multiple field-emission cathode structure is described. The relativistic electron beam (REB) device was operated without the high-voltage anode and coupling structure in place. Beam transmission tests at various voltages are mentioned. The design and the principles of operation of an elliptic cavity Cerenkov coupler are described. Diagrams and photographs of the coupler and high-voltage anode are shown. Author

N65-17048# Microwave Associates, Inc., Burlington, Mass.
VARACTOR DIODE INDUSTRIAL PREPAREDNESS MEASURES Final Report, 25 Jun. 1960–25 Jun. 1964
F. Kupriss, J. Perry, N. Prasinos, and D. Revelotis [1964] 237 p ref
(Contract DA-36-039-SC-85941)
(AD-608659) OTS: $6.00

A summary of the work performed in the following areas: spring machine, silicon mounting operation, alumina reversible cartridge (type I), glass diode (type III), axial Pill diode (type II), R_s measurement and test procedure, passivation, and welded pill III. The results indicate that an efficient production facility has been created, and that the necessary equipment has been fabricated or purchased to manufacture more than 200 varactor diodes conforming to applicable specifications per 8-hr day. Author

N65-17098# Army Electronics Labs., Fort Monmouth, N. J.
RADIATION EFFECTS ON FIELD-EFFECT TRANSISTORS, PART I
Edwin T. Hunter Jun. 1964 31 p refs
(ECOM-2462; AD-609932)

Several varieties of junction gate field-effect transistors were studied to determine transient drain currents upon exposure to single pulses of bremsstrahlung from the White Sands linear accelerator. Data obtained indicate that the transient currents are dependent on the junction volume, and the transconductance. At low gate voltages, where the transconductance is close to its maximum value, the transient I_D is small compared to the operating I_D. However, at gate voltages near pinch-off, the transient I_D is much larger than the operating I_D and may present problems in switching applications. Author

N65-17150# Texas Instruments, Inc., Dallas.
TECHNIQUES FOR EXPERIMENTAL FABRICATION OF A 1-WATT, 1-Gc GALLIUM ARSENIDE TRANSISTOR Final Report, Aug. 1962–Sep. 1964
Melvin Belasco Wright-Patterson AFB, Ohio, AF Avionics Lab., 15 Jan. 1965 155 p refs *Its* Rept.-08-64-165
(Contract AF 33(657)-8757)
(AFAL-TR-64-316; AD-610511)

Fabrication technologies needed to achieve n-p-n GaAs transistor performance, such as emitter formation and base diffusion, were investigated. To make a stripe geometry transistor, one adaptable to widely varying geometries, several combinations of Sn, Ge, Au, and Al were investigated as emitter

materials. One, Sn-Al(2%), was used almost exclusively in the standard transistor process. Both two-stripe and three-stripe GaAs transistors were made using Mg-Mn diffused base layers that had been reduced in thickness by an etching procedure. A method of diffusing Zn into GaAs to produce uniform base layers reproducibly was developed using techniques for sputtering both SiO_2 and Zn. To determine the importance of various process parameters, theoretical studies were made of various device structures to predict their characteristics. Intensive studies were also made of the electro-optical properties of the GaAs in an attempt to determine material characteristics, such as diffusion lengths and impurity levels, that could be related to transistor performance. Author

N65-17185# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSFORMER OF CONTINUOUS VALUES (VOLTAGE, CURRENT, ILLUMINATION) INTO DISCRETE ONES
V. A. Gorokhov 7 Jan. 1965 4 p Transl. into ENGLISH of Russian Patent No. 160038 (Appl. No. 698263/26), 21 Aug. 1961 2 p
(FTD-TT-64-623/1+2; AD-610339)

A converter is described that transforms continuous signals from voltage, current, or light intensity, into discrete pulses whose frequency is directly related to the parameter being measured. This linear dependence of the pulse frequency on the input value is obtained by using a semiconductor triode in the grid circuit of a controlling triode tube. D.E.W.

N65-17192# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CREATION AND ADOPTION OF SYSTEMS OF ELECTRICAL EQUIPMENT
N. A. Obolenskiy 9 Jan. 1965 12 p Transl. into ENGLISH from Elektrichestvo (Moscow), no. 4, 1964 p 1–4
(FTD-TT-64-827/1; AD-610331)

The creation and adoption of progressive systems of electrical equipment for electrical power generation at thermal and hydroelectric stations and the distribution of this power are discussed. The problems of creating heavy-duty turbo- and hydrogenerators, transformers and autotransformers with voltage control under load, static transformers, and high voltage commutation devices, as well as equipment assuring control, stability, protection and automation of electrostation and power generating system operations are presented. G.G.

N65-17221*# CBS Labs., Stamford, Conn. Electron Tube Dept.
1-1/2 INCH RUGGED IMAGE DISSECTOR TUBE Final Report, 25 Feb.–18 Sep. 1964
S. Juchnowycz 12 Oct. 1964 39 p Prepared for JPL
(Contract NAS7-100; JPL-950848)
(NASA-CR-60747) OTS: HC $2.00/MF $0.50

An extremely rugged image dissector tube was developed that is capable of withstanding mechanical shock and vibration greatly in excess of requirements for the Mariner C space flight to Mars. Technical progress is reported in the control of dynode and cathode uniformity, and of dark current. Specific areas of improvement over an earlier model of image dissector include the addition of snubbers to the electron multiplier assembly, the provision of specially formed tabs on all cylindrically mounted and welded components, the design and construction of tooling for the precision manufacture of the image section components, and the establishment of critical assembly techniques using the latest welding technology. D.E.W.

N65-17225# New York Univ., N. Y. Lab. for Electroscience Research
GAIN-BANDWIDTH LIMITATIONS AND OPTIMUM DESIGN OF WIDE-BAND PARAMETRIC RC CONVERTERS Scientific Report No. 13
Jacob Klapper and Mohammed S. Ghausi Oct. 1964 96 p refs
(Contract AF 19(628)-379)
(AFCRL-64-994; TR-400-102; AD-610490)

This report discusses the gain-bandwidth limitations and optimum design of noninverting converters comprised of a parametric conductance in parallel with a parametric capacitance pumped in time quadrature. The circuit is of the circulator type, and the desired passband is about the isolation center. An LC equalizer is inserted between the converter and the circulator, and the design is based on the optimization of this equalizer. Two types of fundamental limitations of gain and bandwidth are discussed: those due to the converter proper and independent of the associated circuitry, and those due to the LC character of the equalizer. An approximation is made to the normally nonpositive real admittances of the converter which allows the use of the theory of matching. The synthesis is performed on a lowpass circuit with a lowpass to double-bandpass transformation completing the design. An illustrative example considers a converter with a bandwidth of about 120 percent of center frequency. Author

N65-17240# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
RESEARCH ON TECHNIQUES FOR INTEGRATION OF ACTIVE ELEMENTS INTO ANTENNAS AND ANTENNA STRUCTURE Interim Engineering Report, 1 Sep.–30 Nov. 1964
30 Nov. 1964 25 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-15; AD-456348)

The design of a 1000-mc slot antennafier is presented. The small signal equivalent circuit of a transistorized rf amplifier with improved cross modulation performance, and the patterns of a four-element phase-locked array of dipole antennafiers are described. An active, constant-amplitude, 455-kc phase shifter was tested. The effects of mutual coupling on the amplitude and phase distributions of an n-element array are discussed, and the design of a diode operated digital time-delay network suitable for use in an array is presented. Author

N65-17274*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS, PHASE I Final Report, 16 Jul. 1963–16 Oct. 1964
R. N. Edwards, ed. [1964] 145 p refs
(Contract NAS3-2546)
(NASA-CR-54247) OTS: HC $4.00/MF $1.00

Prototype space switchgear development was detailed for high temperature operation in a nuclear radiation environment. Existing techniques for current interruption were evaluated. Suitable contact materials were selected, and electrode elements were prepared for testing. High frequency ac interruption was demonstrated in a high temperature switching device, compatible with the space nuclear electrical system environment. High voltage dc interruption without restrike was also demonstrated in another device. E.P.V.

N65-17315*# ITT Federal Labs., Nutley, N. J. Electron Tube Lab.
MILLIMETER-WAVE CONVERTER STUDIES Final Report, May 14, 1962–Jan. 15, 1963
R. C. Wertman and R. W. Wilmarth [1963] 102 p refs
(Contract NASw-430)
(NASA-CR-50732) OTS: HC $4.00/MF $0.75

It was found that the building of a low noise, wide bandwidth, electronically tunable converter in the millimeter-wave range was feasible. The theory of operation of the backward wave converter was determined by two different methods—space charge analysis and ballistic analysis. The ridge loaded meander line was considered the most suitable type of slow wave structure after a detailed analysis was made of it, and of the Karp structure. The required structures can be fabricated using available skills and techniques. The electron gun and cathode needed are within the present state-of-the-art. The noise figure of the tube should be no more than 15 dB, and the weight and power requirements of the device are reasonable for use in a planetary spacecraft. R.L.K.

N65-17374# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
CONTROLLED ELECTRON BUNCHER
William C. Quinn and Frank E. Welker Oct. 1964 20 p refs
(RADC-TDR-64-453; AD-608899)

A method for forming and accelerating isolated high density bunches of electrons is described. The device is capable of either repetitive or single-shot operation. A theoretical treatment is given, and experimental results are discussed. Nine experimental models were fabricated and the principles of operation were demonstrated. Author

N65-17379# Photocircuits Corp., Glen Cove, N. Y.
MICROMINIATURE LAYERED PRINTED WIRING Final Report, 15 Jun. 1962–15 Aug. 1963
B. Messner, R. Mc Can, and M. Paluszek [1963] 203 p

The results of work performed proved the feasibility of producing microminiature multilayered printed wiring boards with plated-through holes located on 0.050-in centers. The results of tests performed on 400 samples of three different patterns demonstrated that such boards can withstand the environmental conditions specified in SCL-7653 specifications and will generally meet the requirements of this specification, with certain minor exceptions or deviations. The design and processing requirements for the manufacture of such microminiature multilayer boards were established and reflected in recommended purchasing specifications. All processes required and employed in the manufacture of such boards are within the scope of the present state-of-the-art of the printed wiring industry. Description and discussion of testing procedures and test results obtained from samples of microminiature multilayer printed wiring boards are given. Author

N65-17426 Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 150 mc) Fourth Quarterly Progress Report, 15 Apr.–15 Jul. 1964
R. A. Auriemma and W. D. Peterson 12 Oct. 1964 12 p refs
(Contract DA-36-039-AMC-03207(E))
(Rept.-523-1000651-00152F; AD-450235)

Experimental work concerned with the emission characteristics of the radial filament configuration was conducted. The results of this experimentation are reported. These include data on uniformity of plating thickness over the thickness range from 500 Å to 2000 Å, a measure of the repeatability of plating thickness for a given load of aluminum, data on plating thickness versus load, and a formula for computation of the amount of aluminum needed to achieve a given thickness of plating. A comparison is made of the results obtained using different frequency sources for the Schering Bridge method of measuring motional parameters. These show the need for a stable frequency source in making such measurements. Difficulties encountered in polishing crystals due to breakage of blanks are mentioned. Author

N65-17445# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNITS CR-(XM-47)/U Interim Summary Report, 1 May–31 Jul. 1964
J. H. Sherman, Jr. [1964] 46 p
(Contract DA-36-039-AMC-02232(E))
(AD-456555)

Work continued in the development of a microminiature crystal unit in the frequency range of 7 to 20 Mc. The discrepancies between target specifications and realized parameters are indicated. The electron beam weld closure is confirmed. Design deficiencies in the header are described, their effect in jeopardizing the quality and yield of crystal units is explained, and a proposal for redesign is described. Author

N65-17469# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
RESEARCH ON TECHNIQUES FOR INTEGRATION OF ACTIVE ELEMENTS INTO ANTENNAS AND ANTENNA STRUCTURES Interim Engineering Report, 1 Jun.–31 Aug. 1964
J. F. Rippin, Jr. 1 Sep. 1964 22 p refs
(Contract AF 33(657)-10386)
(Rept.-1566-13; AD-449446)

An equivalent circuit of a slot antenna is being studied so that the slot may be matched directly to the input of a transistorized amplifier. A transistorized rf amplifier, with a 20 dB improvement in cross-modulation performance over the conventional grounded-emitter circuit, was developed, and a 420 mc T-bar slot antennafier was designed and tested. A four-element array of dipole antennafiers with electronic phase and amplitude control, a six-element phase-locked array, and a method of separating the output spectrum of a spiral antenna into many channels, are discussed. Author

N65-17478# General Electric Co., Lynchburg, Va. Communication Products Dept.
MICROMINIATURE CRYSTAL UNITS CR-(XM-47)/U Quarterly Report, 1 Aug.–31 Oct. 1964
John H. Sherman, Jr. [1964] 15 p
(Contract DA-36-039-AMC-02232(E))
(QR-5; AD-457117)

Efforts were directed toward reducing to completed and issued drawings the component parts of the CR-(XM-47)/U; searching for vendors capable of producing these parts; attempting to reduce the resistance at the low frequency end of the specified range; and developing a concept of the terms "hermetic seal," "leak," and "leak test" that is meaningful in the microminiature context. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-16370 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF A REFLEX KLYSTRON IN THE PRESENCE REFLECTOR CURRENT
L. A. Belov *In its* Izv. VUZov: Radiophys., Vol. VII No. 4, 1964 14 Jan. 1965 p 213–229 refs (See N65-16351 07-23) OTS: $6.00

In a kinematic approximation, the operating regime of a reflex klystron with reflector current is considered. The mechanism of electron density bunching on the reflector plane and when returning to a gap is investigated. The form of reflector and resonator current pulses was studied; expressions were obtained for the harmonics of these currents. The peculiarities of the operation of a klystron autogenerator, connected with the appearance of the reflector current, are discussed. Author

N65-16371 Joint Publications Research Service, Washington, D. C.
THE DYNAMICS OF A FRUHAUF CIRCUIT ASSEMBLED FROM SEMICONDUCTOR TRIODES
M. A. Chubarov *In its* Izv. VUZov: Radiophys. Vol. VII, No. 4, 1964 14 Jan. 1965 p 230–245 refs (See N65-16351 07-23) OTS: $6.00

The dynamics of a Frühauf circuit are considered with piecewise linear approximation of the static characteristics of the transistors, and a consideration of the small parasitic parameters. The existence of autooscillations is demonstrated, and their period and amplitude are found. Author

N65-16372 Joint Publications Research Service, Washington, D. C.
DYNAMICS OF LINEAR ELECTRIC CIRCUITS AT CYCLIC SWITCHINGS
B. I. Yakhinson and A. S. Rozenfel'd *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 246–257 refs (See N65-16351 07-23) OTS: $6.00

A method is discussed of compiling a system of linear difference equations for investigation of transient and steady-state regimes of a linear electric circuit, at the input of which an idealized immediate-action key is switched on and off multiply. Formulas are obtained for determining the coefficients of the difference equations directly from the input resistance (conductivity) of the circuit with constant parameters and forced components of key current and voltage. The conditions of the establishment of a periodic process in the current with the key are considered. Author

N65-16373 Joint Publications Research Service, Washington, D. C.
HARD REGIME OF TRIGGER AUTOOSCILLATIONS
M. I. Feygin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 258–297 refs (See N65-16351 07-23) OTS: $6.00

A region of values of trigger parameters was found in which two stable equilibrium states and stable relaxational autooscillations occur. The period of the autooscillations was calculated, and an evaluation was made of the possibilities of switching a trigger from one stable regime to others by means of a narrow pulse. Author

N65-16418*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
DETERMINATION OF ELECTRICAL CONDUCTIVITY OF MATING SURFACES—A LITERATURE SURVEY Final Report
W. E. Woolf Dec. 1963 163 p refs
(Contract NAS8-5292)
(NASA-CR-60526) OTS: HC $5.00/MF $1.00

A bibliography containing 477 entries on the subject of electrical impedance between mating metallic surfaces, is presented; in most cases an abstract is included. The report contains a brief analysis or survey of results related to topics such as measurement of low impedance bonds, physical and chemical factors affecting the bond, changes of bond impedance with time, and lesser known methods of determining bond characteristics. Author

N65-16439*# Tennessee Univ., Knoxville. Control Theory Group
DESIGN OF MINIMUM ENERGY DISCRETE-DATA CONTROL SYSTEMS Scientific Report No. 7
A. M. Revington and J. C. Hung 30 Jan. 1965 20 p refs
(Grant NsG-351)
(NASA-CR-60604) OTS: HC $1.00/MF $0.50

A procedure is developed for designing the minimum energy discrete-data control of an nth order continuous plant. The system is required to reach a desired final state from a given initial state in N sampling periods, with N>n. A very useful matrix, called derived matrix, is developed, which expresses the relationship between the canonical vectors. The minimum energy controller depends only on the derived matrix, a very simple result. The importance of minimum energy control is discussed, and an example is given to demonstrate the method. Author

N65-16443# General Precision, Inc., Little Falls, N. J. Research Center
CONTROL AND GUIDANCE THEORY RESEARCH AT THE AEROSPACE RESEARCH CENTER
2 Nov. 1964 18 p refs
(ETO-717)

In an effort to develop practical tools, which can be used by engineers for the design of guidance and control systems for aerospace vehicles, research based primarily on mathematical principles already developed was done on the following programs: *Study of Trajectory Optimization Techniques, Trajectory Optimization Computer Program, Extensions to the Kalman Filter Theory, Techniques of Feedback Guidance and Control, Optimum Interception, Optimum Rendezvous, Control of an Aerodynamically Unstable Booster, Space Vehicle Attitude Control, Models for Aerospace Vehicles,* and *Digital Computer Simulation Programs.* R. L. K.

N65-16592*# National Aeronautics and Space Administration, Washington, D. C.
THE ABSOLUTE STABILITY OF NONLINEAR AUTOMATIC CONTROL SYSTEMS [OB ABSOLYUTNOY USTOYCHIVOSTI NELINEYNYKH SISTEM AVTOMATICHESKOGO REGULIROVANIYA]
B. Zh. Maygarin Feb. 1965 19 p refs Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (Alma-Ata), v. 19, no. 11, 1963 p 58–67
(NASA-TT-F-267) OTS: HC $1.00/MF $0.50

The absolute stability of nonlinear automatic control systems with tachometric feedback is studied, and the position loading of a hydraulic actuating mechanism is calculated. Author

N65-16647 European Organization for Nuclear Research, Geneva (Switzerland). Synchro-Cyclotron Machine Div.
SOME WIDE-BAND QUARTER WAVELENGTH LINE COUPLING CIRCUITS
A. Susini 20 Nov. 1964 105 p refs
(CERN-64-48)

The problem is stated as follows: The power tube and power supply have to be designed in order to keep a given voltage V_1 (peak rf value) constant at the resonator end when the operating frequency varies between $\omega_n - \Omega$ and $\omega_n + \Omega$. The resonator characteristic impedance $Z_n \triangleq \sqrt{L/C}$ is also supposed to be known from geometrical and beam loading considerations. As a reference, a brief description is given of the operating conditions in the trivial case when the tube is directly coupled to the resonator. Later, the quadrupole-type coupling systems with two and three peaks

in the pass band are taken into consideration, and their advantages with respect to the previous case are put into evidence. Author

N65-16769# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut für Flugfunk und Mikrowellen

OPTIMIZATION OF LINEAR SYSTEMS FOR RANDOM SIGNALS [OPTIMIERUNG LINEARER SYSTEME FUR STATISTISCHE SIGNALE]

E. Sappl Oct. 1964 108 p refs In GERMAN; ENGLISH summary

(DVL-368; DLR-FB-64-24) Available from ZLDI, Munich: 25,70 DM

The theory of optimal linear systems for random signals is treated in the frequency domain. The mathematical foundations are given by the introduction of Fourier and Laplace transformations. The transducer properties of linear systems are explained and the random processes are described by correlation functions and spectral densities. The interactions between random processes and linear systems are discussed, and references to applications of the optimization theory are presented. Author

N65-16829*# Martin Co., Baltimore, Md. RIAS Div.

STOCHASTIC PROBLEMS IN OPTIMAL CONTROL

W. M. Wonham May 1963 42 p refs

(Contracts NASr-103; AF 49(638)-1206; DA-36-034-ORD-3708Z)

(NASA-CR-50923; RIAS-TR-63-14) OTS: HC $2.00/MF 0.50

This report is a brief introduction to stochastic optimal control theory as this subject has developed in the past four years or so. The state of theory is still somewhat primitive and few computational results have been reported in the literature. Therefore, only the framework for a general class of stochastic (Markovian) control problems is described, and two examples are given. Author

N65-16906# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering

COMPARISON OF HIGH-GAIN-LINEAR AND SELF-ADAPTIVE FLIGHT CONTROL SYSTEMS FOR A TYPICAL WINGED RE-ENTRY VEHICLE

Robert E. Beale and Frazier J. Hellings (M.S. Thesis) May 1963 139 p refs

(GGC/EE/63-2; AD-411806)

To establish the differences between self-adaptive and normal linear designs, both systems are applied to the problem of controlling the short-period dynamics of the X-15 research vehicle, in the altitude range of sea level to 140000 ft at speeds from Mach 0.2 to Mach 6. Computer response data show that both systems will meet the criteria for command and disturbance inputs. From this linear analysis of design procedures and response data, it is concluded that the high-gain linear system is preferred to a self-adaptive system; however, an analysis of the effect of system nonlinearities, and component noise must be made before a fixed-gain system can be applied to the physical problem of widely varying vehicle parameters. Author

N65-16909# Joint Publications Research Service, Washington, D. C.

DEVELOPMENT OF ALGEBRAIC THEORIES OF AUTOMATIC MECHANISMS IN RUMANIA

S. Rudeanu 16 Feb. 1965 6 p refs Transl. into ENGLISH from Gaz. Mat. (Bucharest), v. 69, no. 9, Sep. 1964 p 321–324 (JPRS-28776; TT-65-30342) OTS: $1.00

A method for the description and synthesis of sequential operations by means of characteristic equations is discussed, based on the principle of the separation of variables. Discrepancies appear between the ideal description of the operation and the real operation, leading to so-called "hazard" phenomena. It was shown that the theory of the real operation of contacts becomes a particular case of the theory of multipositional contacts. These were treated by means of Boolean functions and by imaginary Galois bodies. It is concluded that these ideas have broad general applications, but that the idea of finite abstract automata is not sufficient to dominate the study of real automata. E.P.V.

N65-17073*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics

RECENT DEVELOPMENTS IN PARAMETRIC MULTIPLIERS

Robert P. Rafuse [1963] 10 p refs Presented at the Natl. Electron. Conf., Chicago, 28-30 Oct. 1963

(Grant NsG-419)

(NASA-CR-52451) OTS: HC $1.00/MF $0.50

The idler theory has been augmented to include the 1-2-3-4 quadrupler and the 1-2-4-6-8 octupler. The results thus far indicate that "extra" idlers can significantly improve both efficiency and power handling over the minimal idler case. The overdriven doublers, both abrupt and graded, have been analyzed with simple models for the forward characteristics. As expected, power handling increases greatly, accompanied by a significant increase in efficiency. The most efficient doubler uses an overdriven graded junction. Experimental results are described, together with observations on the causes and cures of spurious oscillations. Author

N65-17077# Martin Co., Baltimore, Md. RIAS Div.

NONLINEAR SYSTEM ANALYSIS AND SYNTHESIS. PART II: STUDY OF THE LUR'E PROBLEM AND OF STOCHASTIC OPTIMAL CONTROL

R. E. Kalman Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 142 p refs

(Contract AF 33(657)-8559)

(FDL-TDR-64-58, Pt. II; AD-610197)

The construction of Lyapunov functions by machine methods, especially as regards the so-called problem of Lur'e, and the formulation of stochastic optimization problems were studied. Also included were general discussions on (1) the absolute stability of sampled-data control systems, a system of finite difference equations, and a nonlinear sampled-data system; (2) irreducible realizations and the degree of a matrix of rational functions; (3) resolution of the problem of Lur'e; (4) near optimal control in the presence of small stochastic perturbations; (5) the differential equations satisfied by conditional probability densities of Markov processes, with applications; (6) the stochastic maximum principle, fixed-time of control; and (7) a time-domain successive approximation method for some linear optimal stochastic systems. Author

N65-17112# Picatinny Arsenal, Dover, N. J.

EXPERIMENTAL INVESTIGATION OF ANTENNA CHARACTERISTICS OF RANDOM LENGTH WIRES WHEN TERMINATED IN A TWO-OHM LOAD

Abraham Grinoch Nov. 1964 46 p refs
(PA-TM-1532; AD-452614)

Described are the tests conducted on five specific wire configurations with blasting caps attached, for the purpose of determining their antenna characteristics. These configurations were formed from insulated wire similar to that furnished with M6 blasting caps. The five configurations were tested to determine their receiving characteristics by measuring (with suitable instrumentation) the current flowing in the bridgewire of the blasting cap as the result of electromagnetic energy abstracted by the antenna from the impinging field. Author

N65-17168# Wisconsin Univ., Madison. Mathematics Research Center
PRACTICAL AVERAGING CIRCUITS
Donald G. Watts Oct. 1964 11 p
(Contract DA-11-022-ORD-2059)
(MRC-518; AD-608857)

Simple practical circuits for on-line averaging of continuous quantiles are given together with an explanation of why a simple averaging circuit, such as a first-order exponential lag, provides good averaging in spite of the fact that its impulse response is a very poor approximation to the ideal finite-time averaging circuit. It is shown that an averaging circuit should be chosen on the basis of a step response. Author

N65-17421# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
ADAPTIVE SAMPLING IN DIGITAL CONTROL
Kenneth Allen Mc Collom and R. M. Stewart, Jr. Aug. 1964 99 p refs
(Contract W-7405-ENG-82)
(IS-995) OTS: $4.00

This study provides a set of design curves from which effective digital control for an experiment can be obtained and at the same time efficient use of a digital computer, shared with other experiments, can be realized. The state variable technique is used as both a design method for obtaining the design curves for adaptive sampling and for predicting the states for control of the process. The method is general enough to allow use by a control engineer who has, or can develop, an adequate mathematical model for the process. Use of this method demonstrates an interesting and useful characteristic for process systems which have particles or components that originate at the input of the process, are carried through the process in space and time, and, finally, are expelled from the process never to return. These processes are commonly described by a set of nonlinear differential equations with time-varying coefficients. Author

N65-17446# Martin Co., Orlando, Fla.
EXCITATION AND DETECTION TECHNIQUES FOR MILLIMETER WAVE TRANSITIONS Ninth Quarterly Progress Report, 1 Jul.–1 Oct. 1964
J. J. Gallagher, R. G. Strauch, and R. E. Cupp Jan. 1964 29 p refs
(Contract DA-36-039-SC-90753)
(OR-6219; AD-455545)

A Ramsey excitation system, a semiconfocal interferometer, and a flat plate interferometer were investigated in the electric resonance system. Studies of the use of an interferometer in an ammonia maser are discussed. A proposed technique for stabilization of a 300-gc carcinotron is reported, and measurements made on submillimeter wave harmonic mixing are shown. The status of spectroscopic investigations and millimeter techniques is briefly reviewed. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-16348*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
HISTORICAL ORIGINS OF NASA'S LAUNCH OPERATIONS CENTER TO JULY 1, 1962
Francis E. Jarrett, Jr. and Robert A. Lindemann Oct. 1964 324 p refs *Its* KSC Historical Monograph No. 1
(NASA-TM-X-54991; KHM-1) OTS: HC $7.00/MF $1.75

This study traces briefly the development and growth of the launching agency, NASA Launch Operation Center. A calendar of chronological events from 1926 through June 1962 is included. Histories of different space programs are discussed briefly. These include the transfer from Kummersdorf to the Redstone Arsenal, Redstone guided missile development, the Missile Firing Laboratory, the Launch Operations Directorate, and the establishment of NASA and of the John F. Kennedy Space Center. Descriptions of launchings of the following missiles are included: Early Redstone, Jupiter C, Jupiter, Juno II, Pershing, Mercury–Redstone, Saturn, Ranger, and Centaur. Copies of 10 supporting documents important in the development of the program are shown. R.E.S.

N65-16349*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN ILLUSTRATED CHRONOLOGY, APRIL 1957 TO JUNE 1964
Evelyn Falkowski 10 Aug. 1964 116 p
(NASA-TM-X-54992; MHR-3) OTS: HC $3.00/MF $0.75

The subject matter covered includes the origin of the Saturn project, the transfer of Saturn to NASA, configuration decisions, Saturn development, the first flight, the selection of the lunar landing vehicle, the approval of the intermediate Saturn model, facilities growth, research and development progress, the starting of Saturn V for lunar landing, Saturn I second-stage success, Saturn launchings, major program milestones, Saturn missions, Saturn characteristics, and Saturn major contractors. R.L.K.

N65-16581*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VISUAL ASPECTS OF A FULL-SIZE PILOT-CONTROLLED SIMULATION OF THE GEMINI-AGENA DOCKING
Jack E. Pennington, Howard G. Hatch, Jr., Edward R. Long, and Jere B. Cobb Washington, NASA, Feb. 1965 28 p refs
(NASA-TN-D-2632) OTS: HC $2.00/MF $0.50

A full-size pilot-controlled simulation of the Gemini–Agena docking has been completed by using a six-degree-of-freedom dynamic simulator. The simulation was composed of three studies designed to investigate (1) the pilot's ability to aline the Gemini and Agena vehicles by using only visual information (no instruments) and displacement control, (2) terminal docking accuracies by using the direct control mode in attitude as well as translation under both day and night lighting conditions, and (3) visual aids which could increase the pilot's precision and confidence in the docking maneuver. Results indicate that both a lack of available visual cues and the pilot's control were responsible for the terminal errors. With adequate visual information pilots were able to complete a successful docking consistently under both day and night lighting conditions. Author

N65-16582*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF JET IMPINGEMENT ON SURFACES OF FINE PARTICLES IN A VACUUM ENVIRONMENT
Norman S. Land and Leonard V. Clark Washington, NASA, Feb. 1965 35 p refs
(NASA-TN-D-2633) OTS: HC $2.00/MF $0.50

The erosion characteristics of a bed of fine particles under vacuum conditions (10^{-4} torr) resulting from an impinging jet exhaust were investigated for various particle sizes and jet heights above the dust surface. The investigation included measurements of the craters during erosion, measurements of the visibility reduction, and photographs of the erosion process. The results of this investigation indicate that there exists a finite jet height above which particles will not be eroded. This height, for given nozzle conditions, varies with surface-particle size. In addition, the results indicate that the magnitude of surface erosion also depends on surface-particle size; erosion is most rapid with the coarsest particles. These and other associated test results are presented and compared with available theory. Author

N65-16633# Federal Aviation Agency, Washington, D. C. Environmental Development Div.
FOG CHAMBER TESTS OF CATEGORY II APPROACH, TOUCHDOWN AND RUNWAY CENTERLINE LIGHTING SYSTEMS Interim Report
Leslie C. Vipond Nov. 1964 49 p Prepared from data obtained from California Univ.
(Contract FAA-ARDS-434)
(RD-64-107)

Nighttime tests showed that the present visual aids could be considered adequate, although marginal, for Category II operations. However, a need for better threshold lighting and more candlepower in the runway centerline lighting was indicated. During the daytime tests, where the higher background brightness was found to have a profound influence on required intensities, the following were concluded: (1) The modified approach pattern was more effective. (2) Bolder threshold lighting was a necessity. (3) Light output of touchdown zone lights should be improved. (4) Runway centerline lights needed a minimum of 2000 peak cp, with 7500 cp preferred, to make them effective in bright daylight fog. (5) There was a definite need for well maintained painted runway markings to supplement the lighting in bright daylight fog. It should be borne in mind that the test results in this report are subjective. There was no way to measure the pilots' abilities to use the information received from the visual aids to make corrections. Author

N65-16840*# Rocketdyne, Canoga Park, Calif.
STABILITY RATING PROGRAM FOR LARGE ROCKET ENGINE SYSTEMS. PHASE II Final Report
R. A. Byron 19 May 1964 66 p refs Revised
(Contract NAS8-1522)
(NASA-CR-56114; R-5504) OTS: HC $3.00/MF $0.75

A hydraulic pulser was developed which is capable of delivering a repeatable, variable-amplitude pressure pulse to the feed system of an operating engine to induce instability. The pulse amplitude can be varied from approximately 10000 to 14000 psi by proper selection of shear pin strength. In experimental application to a 180000-lb-thrust LOX/RP-1 engine incorporating the standard type 10810 injector, the pulser triggered sustained combustion instability. In additional tests with the hardware modified to reduce the injector pressure drops, the engine did not remain unstable when pulsed, although several cycles of chamber pressure oscillations were initiated on occasion. The pulser apparently could not trigger a 1 500 000-lb-thrust LOX/RP-1 engine which was consistently triggered with 13.5-grain bombs. Author

N65-16962# Aerospace Corp., El Segundo, Calif. Electronics Div.
RANGE RATE AND ANTENNA ANGLE DATA EVALUATION STUDY
A. Grossman and D. E. Regan Dec. 1964 96 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-287; TDR-469(5110-01)-1; AD-455533)

A postflight evaluation of range-rate and antenna-angle data resulting from satellite control support operations of a particular program was accomplished. The data span covered a period of four months from late calendar year 1963 to early 1964. The analysis provides a quantitative assessment of the range rate and angle tracking system accuracies, tracking data handling procedures, and orbital determination uncertainties. Author

N65-16982*# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
DEVELOPMENT OF LAUNCH VEHICLE OPTIMIZATION SYSTEMS UTILIZING THE SYSTEM OPTIMIZATION AND REVIEW TECHNIQUE Progress Report No. 2, 1-31 Aug. 1963
[1963] 4 p
(Contract NASw-766)
(NASA-CR-52514) OTS: HC $1.00/MF $0.50

The development of launch vehicle optimization by computer techniques is proceeding as follows: (1) definition of a generalized launch system in terms of the interconnected subsystems is nearing completion; (2) a stable platform guidance system has been selected for detailed analysis by the Westervelt technique; (3) data for this analysis have been collected; (4) definition of the guidance subsystem behavior in terms of cost, reliability, weight, performance, and other parameters is proceeding; (5) redefinition and development of computer methods to adapt the Westervelt technique to launch vehicle and propulsion problems has begun; and (6) extension of the processed data to the analysis of the entire launch vehicle complex awaits completion of the other tasks. M.P.G.

N65-17090# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ELECTROTHERMAL GUN FOR HYPERVELOCITY BALLISTICS RESEARCH
C. N. Scully, E. A. Escallier, F. D. Rosen, and J. D. O'Keefe 17 Nov. 1964 28 p refs Presented at the 7th Hypervelocity Impact Symp., Tampa, Fla., 17 Nov. 1964
(SID-64-1156)

A new version of an electrothermal gun, designated as the SSL Mark IV was developed. The gun accelerates spherical silicate projectiles in the 10^{-8} to 10^{-6} gram range at velocities up to 20 km/sec. Projectile spheres are accelerated by fluid drag forces induced by a dense lithium plasma flowing through a nozzle, between a capacitor discharge fed arc chamber and an evacuated flight range. The complete system is equipped with a projectile monitor to verify the geometric integrity of each uniform transparent projectile sphere. During the 3700 firings in the Mark IV, meteor luminosity and ionization, penetration functions, ballistic limits of single sheet and multilayer configurations, impact flash relations, and meteoroid impact sensor behavior have been determined. Author

N65-17141# Lexington Labs., Inc., Cambridge, Mass.
INVESTIGATION OF A HIGH TEMPERATURE ELECTRICAL CONDUCTIVITY DEVICE FOR USE WITH THERMAL IMAGE HEATING Final Report, Dec. 1963–Nov. 1964
Philip S. Schaffer, Henry A. Hobbs, Jr., and Robert C. Folweiler
15 Dec. 1964 63 p refs
(Contract AF 19(628)-1616)
(AFCRL-64-1012; AD-610496)

The double-clamshell imaging system was successfully used to measure electrical conductivity of single crystal and polycrystalline aluminum oxide, and pyrolytic boron nitride in the absence of impressed electric and magnetic fields. A furnace with a controlled atmosphere was designed and constructed for the conductivity measurements up to a temperature greater than 2130° K. Two 5000-watt xenon arc lamps were used for energy sources. At 1500° K a temperature gradient of 6° K along the empty furnace axis was measured with alumina-shielded thermocouples. The thermal conductivity of a sample reduced the gradient to less than 1° K. Author

N65-17153# Rhodes and Bloxsom, Canoga Park, Calif.
CALIBRATIONS OF RHODES AND BLOXSOM MICROMETEORITE ACCELERATOR 14.1 TO 36.4 KM/SEC
D. E. Bloxsom, Jr. 1 Aug. 1964 30 p refs

This report deals with a special micrometeorite mix accelerated to 14.1 km/sec in order to calibrate the Rhodes and Bloxsom micrometeorite gun with a special carbon particle mix whose density and number distribution correspond closely to expected micrometeorite densities and number distribution in close earth orbits. Results of the calibration with 1-mil thick aluminum, 7.5-mil thick steel, and 1-inch thick, 2.3 lb/ft^3 styrofoam are presented. Results of the calibration with 27 km/sec microparticles are given. Limit of microparticle accelerator is 84 km/sec. Calibration of mass vs velocity and density is included. In addition 36.4 km/sec at 6.7×10^{-6} gm was achieved. Author

N65-17189# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW TYPE OF TRANSPORTERS OF GREATER LOAD LIFTING CAPACITY
L. I. Gorshkov and L. D. Kuz'mich 9 Jan. 1965 9 p Transl. into ENGLISH from Izheleznodorozhny Transp. (USSR), no. 1, 1964 p 37–39
(FTD-TT-64-685/1+2; AD-610328)

Design and construction details of a 16-axle coupled transporter, with load capacity of 220 to 232 tons, are reported. The transported load is suspended between the separable halves of the transporter on the lugs of the half frames with the aid of rollers and, under the effect of their natual weight, are fastened between support points of the upper bands of the half frame. In such an arrangement the upper zone absorbs the compression forces of the fastening, and the lower zone absorbs the tensile stresses. At a load weight of 232 tons, the fastening force per one supporting point is about 150 tons. E.E.B.

N65-17207# Air Force Office of Scientific Research, Washington, D. C.
U.S. AIR FORCE ACHIEVEMENTS IN RESEARCH
[1964] 162 p
(AD-609830)

Achievements in research by the U. S. Air Force in its own laboratories, and through its support of research in laboratories of universities, colleges, technical institutions, and other research organizations are presented. Subjects include mathematics, engineering, physical, life, and environmental sciences. E.E.B.

N65-17215*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PNEUMATIC MODEL LAUNCHER FOR FREE-FLIGHT TESTING IN A CONVENTIONAL WIND TUNNEL
H. P. Holway, J. G. Herrera, and B. Dayman, Jr. 30 Jul. 1964 21 p refs
(Contract NAS7-100)
(NASA-CR-60755; JPL-TM-33-177) OTS: HC $1.00/MF $0.50

The adoption of ballistic range techniques to a conventional wind tunnel is enhanced through the use of a pneumatic model launcher. The problems encountered during the development are discussed, and the subsequent solutions are presented. An inexpensive technique for the fabrication of expendable models was developed through the use of polystyrene plastic in the injection-molding process. The precision of the free-flight, support-free aerodynamic data is dependent upon the high degree of accuracy in the measurements of both the moment of inertia and the center of gravity. These measurements were made possible with the development of special instruments. Author

N65-17237# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
PRELIMINARY ESTIMATES OF THE TEST-SECTION CHARACTERISTICS IN A HIGH-ENTHALPY, LOW-DENSITY WIND TUNNEL
John R. Krouse Sep. 1964 31 p refs *Its* Aero Rept.-1076 (DTMB-1921; AD-455149)

The initial stagnation conditions are assumed to be a temperature of 9000° R and atmospheric pressure; the steady, one-dimensional, inviscid, adiabatic expansion is terminated at 0.00001 atmosphere. Air is used as the working medium because of its obvious importance to vehicles that operate in and utilize the earth's atmosphere, and also because a fairly extensive amount of literature is presently available concerning its properties over a wide range of temperature and pressure. The computations are performed for both equilibrium and frozen flow processes, thus enabling a physical appreciation for the comparative behavior of the two extremes that serve as upper and lower limits on any nonequilibrium behavior. The variables that are evaluated include the significant physical, thermodynamic, and transport properties, in addition to some of the more important dimensionless aerodyanmic similarity parameters, all of which are presented graphically as a function of nozzle static pressure. It is demonstrated that the test-section characteristics depend on the governing flow process. Author

N65-17263*# Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY. IV: THE DUOPLASMATRON AS A VACUUM ULTRAVIOLET LIGHT SOURCE
J. A. R. Samson and H. J. Liebl Washington, NASA, Sep. 1963 20 p refs
(Contract NASw-395)
(NASA-CR-16; GCA-TR-62-8-N) OTS: HC $1.00/MF $0.50

A light source was investigated that would emit radiation below 1000 Å of comparable intensity to the high-voltage pulsed type but which would operate from a dc supply. It was felt that with the combination of hot filament and axial magnetic field as found in the Duoplasmatron that the light intensity would be comparable with the high-voltage pulsed light sources. A preliminary measurement of the total intensity between 1050 and 1350 Å was made using a nitric oxide ion chamber with a Duoplasmatron as an ion source. Spectrums are determined for hydrogen between 1800 and 900 Å and for argon from 550 to 1100 Å. Author

N65-17264*# Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY. V: VACUUM ULTRAVIOLET LIGHT SOURCES
J. A. R. Samson Washington, NASA Sep. 1963 59 p refs (Contract NASw-395)
(NASA-CR-17; GCA-TR-62-9-N) OTS: HC $3.00/MF $0.50

A study is made of photoelectric detectors, since they provide a high degree of accuracy in the measurement of absorption cross sections. As the intensity of radiation is often the important factor in photoionization measurements, the degree of intenseness is defined as strong if, after dispersion by a grating spectrograph, the radiant flux exceeds 10^8 photons/sec at the exit slit. It appears that several light sources exist which produce useful continua from 3500 to 600 A of sufficient intensity to measure (by photoelectric detection techniques) the (a) absorption cross sections of gases and crystals, and (b) reflectance and transmittance of thin films. Author

N65-17309 Technische Univ., Berlin (West Germany). Institut für Flugführung und Luftverkehr
SYSTEMATIC EXAMINATION OF PRECISION STANDARDS OF THE CURRENTLY APPLIED WAITING PROCEDURES IN CIVIL AVIATION AND THEIR EVALUATION THROUGH ANALYSIS [SYSTEMATISCHE UNTERSUCHUNG DER GENAUIGKEITSWERTE DER IN DER INTERNATIONALEN ZIVILLUFTFAHRT GEGENWARTIG ANGEWENDETEN WARTEVERFAHREN UND DEREN AUSWERTUNG IN FORM EINER STUDIE]
E. Rössger and M. Fricke Düsseldorf, VDI-Verlag, 1964 33 p refs In GERMAN Luftfahrt-Forschungsber. des Bundesmin. für Verkehr No. 23

Radar observations and other measurements were made of the holding pattern for jets over five German airports to find the necessary waiting area. The waiting pattern was evaluated by the pilot's execution of the holding pattern, the waiting altitude, the airspace during waiting time, wind velocity, and the area of the waiting loop. It was concluded that currently applied holding patterns are inadequate for high speed airplanes. New holding areas were found by analysis for 27 holding patterns at 1500- to 45000-ft altitude and 170, 220, and 240 kilometer International Aviation Standard, and are presented. Suggestions for the standardization of the entry procedures for holding patterns of the four-sector type, the three-sector type, and the two-sector type are discussed. G.G.

N65-17480# Eitel-McCulough, Inc., San Carlos, Calif.
RESEARCH ON MICROWAVE WINDOW MULTIPACTOR AND ITS INHIBITION Final Report, 1 Jul. 1962–30 Jun. 1964
Raymond Hayes [1964] 181 p refs
(Contract DA-36-039-SC-90818)
(AD-456965)

The problem of multipactor at microwave windows is discussed and the results of theoretical and experimental studies on multipactor at a single dielectric surface are presented, with information on the power levels at which such discharges may be expected to occur. Methods of eliminating multipactor at windows are described; these include surface coatings, applied by evaporating titanium in vacuum or sputtering titanium monoxide in argon or mercury, and grooves cut in the window surface perpendicular to the electric field. Factors affecting the nature of the surface coatings during application and in subsequent tube processing are described. A wide variety of coatings were evaluated at S-band on alumina, beryllia, and quartz windows at power levels up to 100-MW peak equivalent transmitted power and average dissipations equivalent to over 300 kW of average power. The maximum peak power supported by multipactor resistant windows was limited by arcing at the metal–dielectric seal. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-16343*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE MECHANISM OF NOISE GENERATION BY SUPERSONIC FLOWS — AN ACCOUNT OF RESEARCH WORK
J. E. Ffowcs Williams 19 Jun. 1964 91 p refs
(Contract NAS1-3217)
(NASA-CR-60584; BBN-1140) OTS: HC $3.00/MF $0.75

The exact equations of sound radiation by turbulence are rearranged in a form where the equivalent sources, derivatives of the turbulence stress tensor, are shown to be dominated by one term. That term is formed from the product of the mean velocity gradient and the rate of change of density. In the Mach wave case, the theory is designed to include effects of both temperature gradients and density perturbations, and the approximations of the estimate are of a type that would not be expected valid away from the Mach wave condition. The basic theory is used to make an estimate of the sound radiated from supersonic boundary layers, and an approximate equation relating the radiated pressure to the surface pressure is derived. Experimental evidence is then examined to show that the equation is in excellent agreement with observation. Author

N65-16447*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE STATIONARY LAMINAR VELOCITY BOUNDARY LAYER WITH CONSTANT FLUID PROPERTIES AND ARBITRARY DISTRIBUTIONS OF PRESSURE AND MASS TRANSFER
Ernst W. Adams and Benton K. Berry Washington, NASA, Feb. 1965 87 p refs
(NASA-TN-D-2642) OTS: HC $3.00/MF $0.75

Along sections of stream lines $\psi = \psi_a^*(x, y)$, series expansions representing an inner solution $(0 < y \leq y^*)$ are matched with a closed-form outer solution $(y^* \leq y < \infty)$, whose linearization error vanishes asymptotically as $y \to \infty$. This process yields a nonlinear integro-differential equation for the friction coefficient $c_f(x)\ Re^{1/2}$. The velocity distributions $u_a(x)$ at $y = \infty$ and $u_w(x)$ and $v_w(x)$ at $y = 0$ may be represented sectionally by polynomials. Comparison with other solutions shows that accurate approximations of $c_f(x)\ Re^{1/2}$ can be computed. This accuracy decreases with the number of points where $u_a'(x)$, $u_w'(x)$, and $v_w'(x)$ change their signs. Results presented show the influence of the direction of the mass transfer vector relative to the wall. Generalizations of the method are outlined with respect to compressible boundary-layer flow and a special second-order boundary-layer theory. Rigorously valid bounds for $c_f(x)\ Re^{1/2}$ can be calculated by use of this method and the theorem of Nagumo and Westphal. Author

N65-16586*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INCIPIENT CAVITATION OF FREON-114 IN A TUNNEL VENTURI

Thomas F. Gelder, Royce D. Moore, and Robert S. Ruggeri Washington, NASA, Feb. 1965 13 p refs

(NASA-TN-D-2662) OTS: HC $1.00/MF $0.50

Cavitation of liquid freon-114 (dichlorotetrafluoroethane) was induced on the walls of a Venturi in a closed-return hydrodynamic tunnel. The Venturi used a quarter round to provide the transition from a 1.743-in.-diameter approach section to a 1.377-in. diameter throat section. At a fixed velocity, the incipient-cavitation parameter decreased as much as 30% when the liquid temperature was increased from 0° to 80° F. (The incipient-cavitation parameter is the ratio of the difference between an upstream reference pressure at incipient cavitation, and the vapor pressure to the velocity pressure of the upstream flow.) At a fixed temperature, the parameter increased as much as 50% when the approach velocity was increased from 20 to 47 fps. Values of the incipient-cavitation parameter indicated local effective tensions within the liquid that ranged from 4 to 20 ft of liquid, depending on temperature and velocity. Author

N65-16595*# National Aeronautics and Space Administration, Washington, D. C.

AMETHOD FOR COMPUTING SUPERSONIC FLOW AROUND BLUNT BODIES, ACCOMPANIED BY A DETACHED SHOCK WAVE [METOD RASCHETA SVERKHZVUKOVOGO OBTEKANIYA ZATUPLENNYKH TEL S OTOSHEDSHEY UDARNOY VOLNOY]

S. M. Gilinskiy, G. F. Telenin, and G. P. Tinyakov Feb. 1965 32 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i. Mashinostr. (Moscow), no. 4, 1964 p 9–28

(NASA-TT-F-297) OTS: HC $2.00/MF $0.50

The problem is formulated of supersonic flow around a body, accompanied by a detached shock wave; and on the basis of an analysis of the properties of the solutions of model linear equations of the elliptical and mixed types, the basic ideas of the method are expounded. A numerical method is provided for the solution of the nonlinear problem. Examples are given, illustrating the application of the method in the solution of various problems involved in flow around a body accompanied by a detached shock wave. Author

N65-16632# Argonne National Lab., Ill. Chemical Engineering Div.

EVALUATION OF PHYSICAL PROPERTIES OF GASES AND MULTICOMPONENT GAS MIXTURES

John T. Holmes and Manfred G. Baerns Nov. 1964 25 p refs (Contract W-31-109-ENG-38)

(ANL-6951) OTS: $2.00

Relationships which can be used to estimate the density, heat capacity, viscosity, thermal conductivity, and diffusivity of gases and multicomponent gas mixtures are presented and reviewed. These relationships were incorporated into a computer program for calculation and compilation of the properties for the desired components and mixtures at temperatures and pressures specified by the user. The calculations are made either by extrapolation of experimental data given at conditions other than those desired, or by using the critical and molecular properties of the gases. The computer program was used to solve a sample problem dealing with the physical properties of CO_2, O_2, and N_2 mixtures. Author

N65-16646# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe

HEAT SUPPLY IN THE CASE OF VARIABLE MASS FLOW RATE [WARMEZUFUHR BEI VERANDERLICHER MENGENSTROMDICHTE]

P. Nitsch and N. Schmidt Aug. 1964 75 p refs in GERMAN; ENGLISH and FRENCH summaries

(DLR-FB-64-31) Available from ZLDI, Munich: 12 DM

The influence of heat supply on the variables of state, as well as on velocity, Mach number, and the cross-section variation of a flow with inconstant mass flow rate is investigated. The differential equations representing such a flow are integrated for ideal gases of constant specific heat, whereby always one parameter (Mach number, velocity, pressure, temperature or density) is kept constant. The relations thus obtained for the flow parameters and the cross-section variation are plotted in diagrams, and discussed for initial Mach number from 0.1 to 15 and for values from 0.1 to 12 of the heat supply standardized with the total enthalpy. Author

N65-16695 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF GEOMETRIC PARAMETERS ON BUBBLING OF LIQUID THROUGH LIQUID

V. N. Moskvicheva *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 358–369 ref (See N65-16676 07-33)

The systems, water–mercury and water–carbon tetrachloride, were selected for the study of the influence of geometric parameters of a horizontal plate during the bubbling of a liquid through another liquid. The following parameters were varied during the experiment: hole diameter, effective cross section, height of column, flow rates, and layer components. The measured quantities were height of dynamic layer, column and height of heavy phase, and the flow rate of water. The measured magnitudes made possible the calculation of all other parameters required. The experiments revealed the ambiguity connected with prolonged structure stability. It was concluded that structural changes and the degree of stability are essentially connected with durability of surface film of the heavy component and consequently with the presence of surface-active materials and finely dispersed suspensions. E.E.B.

N65-16696 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF VISCOSITY OF BUBBLING LIQUID ON DENSITY OF LAYER

V. N. Moskvicheva and I. G. Malenkov *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 370–373 (See N65-16676 07-33)

During the calculation of hydrodynamic stability of the bubbling process, it is necessary to consider not only surface tension and specific gravity, but also to consider the influence of viscosity of the lighter component. Measurements of viscosity were carried out on an experimental column 1500 mm in height and 62 mm in diameter. Mercury and water were chosen as the working liquids. The experiment clearly revealed the influence of viscosity of the lighter component on the layer stability of the heavier liquid. It was shown that with the decrease of viscosity of the lighter component, the stability of the layer increases. Also, with the decrease of viscosity, the magnitude of heavy component removal decreases. E.E.B.

N65-16697 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE CALCULATION OF LENGTH OF THE SOLID PART OF A STREAM OF LIQUID DURING ITS BREAKDOWN

L. A. Vitman *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 374–386 refs (See N65-16676 07-33)

A stream of liquid flowing from a round nozzle, due to a series of disturbances (turbulence, ellipticity, or roughness of nozzle), is not strictly cylindrical. Forces of surface tension tend to make the stream cylindrical. As a result, the stream starts to pulsate, and the developed perturbation leads to disturbance of stream stability and breakdown. Formulas are presented for the calculation of the length of stream from nozzle to breakdown point and the time. A sample calculation is performed for a stream of kerosene flowing from nozzle to atmosphere. The parameters given are nozzle diameter, exhaust velocity, viscosity, density, and surface tension. E.E.B.

N65-16708# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Aerodynamik
HYPERSONIC FLOW AROUND SLENDER BODIES [DIE HYPERSCHALLSTROMUNG UM SCHLANKE KORPER MIT KONTUREN DER FORM $R \sim x^n$]
K. Gersten and D. Nicolai Jul. 1964 130 p refs In GERMAN; ENGLISH and FRENCH summary
(DLR-FB-64-19) Available from ZLDI, Munich: 1.950 DM

The inviscid hypersonic flow fields at Mach numbers $Ma_\infty \to \infty$ have been calculated for slender two-dimensional and rotational symmetric bodies with contours of the form $\bar{R} \sim x^n$ ($n \leq 1$) (power-law-bodies). These flow fields are characterized by self-similar solutions. By using the equivalence principle for slender bodies in hypersonic flow the problem can be reduced to an ordinary differential equation of second order. The solutions are singular at the contour. For many values n and ν the solutions have been calculated. The consideration of the well-known limiting cases (Newton–Busemann theory, blast-wave solution, and flow past a wedge and a cone, respectively,) completes the survey of the self-similar solutions for slender bodies in hypersonic flow. Author

N65-16714# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF INFRARED EMISSION FROM HYPERSONIC AIR FLOWS Final Report, Sep. 1961–Oct. 1964
Walter H. Wurster Nov. 1964 50 p refs
(Contract DA-30-069-ORD-3443; ARPA Order 253-62; Proj. Defender)
(CAL-QM-1626-A-16; AD-452421)

Each of the radiative mechanisms which dominate the radiation from air in the temperature range from 3000° to 8000° K is discussed. Temperature and density dependences, and equations are presented. The importance of nonequilibrium radiation involving excited electronic states of diatomic molecules, and present limitations in describing the hypersonic gas cap, resulting from current lack of knowledge of rates and mechanisms of electronic excitation, are mentioned. It is concluded that this area of research constitutes the most important problem in radiation physics of the pure-air gas cap of reentry vehicles. E.E.B.

N65-16767# Montana State Univ., Missoula. Computer Center
ON THE SOLUTION OF THE GENERAL WATER WAVE PROBLEM
R. P. Banaugh Dec. 1964 21 p refs
(TR-1)

A method of solution is given for the general transient motion of the free surface of a liquid. No restrictions are placed upon the amplitudes of the waves or on the shape and depth of the fluid container. In addition, the container may be moving or stationary in time. Author

N65-16785# General Applied Science Labs., Inc., Westbury, N.Y.
COMPARISON OF THEORETICAL PREDICTIONS OF WAKE ELECTRON DENSITY WITH BALLISTIC RANGE MEASUREMENTS
S. L. Zeiberg and W. Daskin 20 Nov. 1964 20 p refs
(Contract ARPA SD-149; ARPA Order 396)
(TR-477; AD-451897)

Comparisons of calculations and ballistic range value measurements for blunt bodies show good agreement over large ranges of electron line density and X/D. The corresponding comparison for a slender cone shows substantial disagreement between calculations and data. The main feature of the disagreement is the rapid decay rate of the experimental data compared to the calculations. Author

N65-16802# Heliodyne Corp., Los Angeles, Calif.
STABILITY OF DUST LADEN TWO-DIMENSIONAL LAMINAR WAKES
Ali Hasan Nayfeh Oct. 1964 48 p refs
(Contract DA-04-495-AMC-458(Y); ARPA Order 360; Proj. Defender)
(RR-6; AD-608712)

The stability of two-dimensional compressible dusty wakes was investigated. An equation is derived for the amplitude of the pressure disturbance. The solution of this equation is sought by perturbing the dust-free solution for small mass fraction of dust to gas. The straightforward perturbation expansion is not uniformly valid far away from the wake axis. A second-order uniformly valid solution was obtained. The results show that the dust can be stabilizing as well as destabilizing, depending on the size of the particles and their distribution. For a uniform distribution of dust and for very small particle size, the dust has a destabilizing effect. As the dust size increases, the destabilizing effect increases to a maximum, and then decreases to zero. As the particle size increases further, the dust will have a stabilizing effect. The quantitative stabilizing or destabilizing effect of the dust depends on the velocity defect and temperature excess at the wake axis. Author

N65-16835*# Michigan Univ., Ann Arbor. Heat Transfer and Fluid Mechanics Lab.
AN EXACT SOLUTION OF THE RAYLEIGH-BESANT EQUATION
Juan M. Nieto and Willy Smith Oct. 1962 13 p refs
(Grant NsG-39-60)
(NASA-CR-52816; Rept.-03424-18-1) OTS: HC $1.00/MF $0.50

A power series solution of the Rayleigh–Besant equation governing the collapse of a spherical cavity in an inviscid fluid is presented. Numerical values for the nondimensional solution $t = t(R)$ are obtained, where R is expressed in terms of the initial bubble radius R_0 and time is expressed in terms of $R_0\sqrt{\rho/p_\infty}$. Author

N65-16883*# Miami Univ., Coral Gables, Fla.
INSTABILITIES IN THE FLOW OF BOILING LIQUID
A. H. Stenning and T. N. Veziroglu Washington, NASA, Feb. 1965 19 p refs
(Grant NsG-424)
(NASA-CR-164) OTS: HC $1.00/MF $0.50

Preliminary two-component two-phase flow experiments using Freon-11 indicated that a one-component two-phase horizontal flow system is more stable than a two-component two-phase downward flow system. Thermal two-phase flow

oscillations and pressure drop two-phase flow oscillations of 60 seconds and 30 seconds per cycle, respectively, were observed as compared with about 3 seconds per cycle for regular oscillations. G.G.

N65-16891*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MODIFIED METHOD OF INTEGRAL RELATIONS FOR SUPERSONIC NONEQUILIBRIUM FLOW OVER A WEDGE
Perry A. Newman Washington, NASA, Feb. 1965 41 p refs
(NASA-TN-D-2654) OTS: HC $2.00/MF $0.50

The standard method of integral relations was modified to obtain better results for inviscid nonequilibrium supersonic flow over wedges. The polynomial profiles assumed for certain integrands in the standard method are not used. Instead, the definite integral itself is replaced by an expression in which the values of the integrand at the upper and lower limits are weighted to account for the nonequilibrium effects. These weighting functions are computed by considering relaxation histories along frozen-flow streamlines. Conversion of the partial differential flow equations to ordinary equations using weighting functions is no more laborious than in the standard method. The resulting approximate system is integrated smoothly from the frozen-flow shock values to the equilibrium asymptotic values. The entropy layer on the wedge surface is not predicted by the approximate system but results from integration of a set of corrected equations. Author

N65-16934# Rhodes and Bloxsom, Canoga Park, Calif.
EXPERIMENTAL EQUILIBRIUM CONDITIONS OF DISSOCIATED AND IONIZED HYDROGEN HYPERSONIC FLOWS
D. E. Bloxsom, Jr. [1963] 6 p refs

Hydrogen to 13000° K and 1000 atm pressure was prepared by electric arc heating techniques. This hydrogen is in equilibrium, partially dissociated and ionized. Flow of this hydrogen in wind tunnel nozzles has been investigated as to gas velocities by means of small particle acceleration to the stream velocity. This terminal velocity permits equilibrium state of the nozzle flows to be determined. Some such flows are in equilibrium; others are not; still others are mixed. Experimental data are presented with correlation to high-temperature hydrogen equation of state. This work has applicability to the testing of spaceship hulls for microparticle impingement as 36.5 km/sec particle velocities have been obtained. Other areas of applicability include nuclear rockets and high specific impulse space engines driven by electrical means. Author

N65-16958# Aerospace Corp., El Segundo, Calif.
MISSION ORIENTED INVESTIGATION AND EXPERIMENTATION: GASEOUS DISCHARGE Semiannual Technical Report, 1 Jul.–30 Sep. 1964
N. Cohen, B. H. Carson, and J. P. Heicklen 30 Jan. 1965 18 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-36; TDR-469(9240-01)-1; AD-456624)

A new technique for measuring the catalytic efficiency of surfaces for atom recombination is based on measuring the heat of atom recombination on the surface of small spherical thermistors. Extensive measurements of catalytic heat transfer to these spheres, which cover an extensive range of Knudsen numbers from continuum to free molecule flow, have been made. An independent measurement of the $O\text{-}O_2$ diffusion coefficient has been obtained. Finally, the new technique is well suited for studying the effects of surface temperature on the catalytic efficiency of materials. Results for the platinum–oxygen atom system are reported. In a flow system, tetrafluoromethane was passed through an electrodeless discharge to produce CF_2 radicals. Ethylene, which was injected downstream of the discharge, reacted completely with the CF_2 radicals present to produce C_3 compounds in a chemiluminescent reaction. Thus, the CF_2 concentration could be monitored both optically and chemically as the mixture flowed down the glow tube. The value of the combination rate constant was estimated to be 10^8 liter/mole-sec. Author

N65-16995# Pennsylvania State Univ., University Park. Graduate School
AIRBORNE INVESTIGATION OF ATMOSPHERIC TURBULENCE
Fred Ray Payne (M.S. Thesis) Sep. 1964 66 p refs
(Contract NOrd-16597; Proj. Windfall)
(AD-608351)

The feasibility of using an airborne hot-wire anemometer was investigated to measure atmospheric turbulences, including power spectra—both up and cross-stream—and to make correlation measurements. The one-dimensional spectra derived from the experimental data agree well with Kolmogoroff's local isotropy postulate over a wave number range of one to three decades. Also included is an analysis of the window characteristics of a wave analyzer of constant bandwidth, which is operable through a center frequency range of 20 cps to 50 kc. G.G.

N65-17045# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (West Germany). Institut für Angewandte Mathematik und Mechanik
THE INSTABILITY OF A STREAMING FLUID LAYER HEATED FROM BELOW AGAINST LONGITUDINAL VORTICES [DIE INSTABILITAT EINER STROMENDEN, VON UNTEN GEHEIZTEN FLUSSIGKEITSSCHICHT GEGENUBER LANGSWIRBELN]
H. True Dec. 1964 63 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-32; DVL-370) Available from ZLDI, Munich: 15 DM

The conditions under which the basic flow becomes unstable on account of longitudinal vortices are examined. Thus, in addition to the thermical lift forces, the effect of a temperature dependent surface tension is also taken into consideration. A linear temperature dependence is assumed for the viscosity μ and the conductivity of heat λ. Generally, the basic flow becomes more unstable (e.g., the critical Rayleigh number diminishes) when the effect of the surface tension is added to the lift forces. Furthermore, the critical Rayleigh number depends essentially on the temperature boundary condition at the boundary surfaces. The influence of the temperature dependent coefficients μ and λ is taken into account by a perturbation theory in first approximation. Author

N65-17102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF PERIODIC PULSATIONS AND OUTER FLOW TURBULENCE ON THE FLOW IN A TURBULENT BOUNDARY LAYER
Rudolf Dvorak 10 Nov. 1964 31 p refs Transl. into ENGLISH from Strojn. Casopis (Prague), v. 13, no. 2, 1962 p 101-122
(FTD-TT-63-1145/1+2; AD-452067)

Presented are theoretical considerations of experimentally demonstrated effects on boundary layer properties by pulsations and linearly smaller disturbances in outer flow. In addition to the theoretical analysis of boundary layer differential equations, certain results are given of simplified solution derivations. Using integration formulas, the practical approximate solutions for a boundary layer on a plane board and for a boundary layer with pressure gradient are made. It is concluded from the analysis that individual periodic pulsations

of outer flow have a small effect on boundary layer development. This conclusion is in agreement with previous experiments. It is also concluded that the effect of pulsation in a turbulent boundary layer will apparently be increased because of the propagation of turbulence and the increased energy dissipation value, and the pulsations can acquire considerable importance where their line value corresponds to the magnitude of intermittent disturbances in the outer zone of the boundary layer. E.P.V.

N65-17146# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
SHOCK TUBE KINETICS RESEARCH AND BALLISTICS RANGE STUDIES Semiannual Progress Report
A. Modica and J. Eckerman 28 Jan. 1965 11 p refs
(Contract DA-31-124-ARO(D)-218)
(RAD-TM-65-8; AROD-5136-1; AD-456051)

The work performed over the past 6 months on shock tube kinetic studies, and the effect of the kinetics of contaminants on wake ionization were summarized. The shock tube work concerns a high temperature study of the mechanism and kinetics of the decomposition and oxidation of C_2F_4 in excess argon. The processes were followed both spectrophotometrically and with a shock tube/TOF mass spectrometer. Appropriate rate constants, equilibrium constants, and heats of formation have been obtained. The wake ionization work involves a ballistics range technique whereby a hypersonic projectile is fired through an argon–cesium atmosphere. The electron-ion recombination in the wake is studied by measuring the wake electron density with a microwave resonant cavity. The technique is described in detail, and a related theoretical procedure for calculating the electron density in a turbulent wake is described. Preliminary experimental results are presented. Author

N65-17149# Southampton Univ. (England). Dept. of Aeronautics and Astronautics
COUPLING BETWEEN ATOMIC RECOMBINATION AND VIBRATIONAL RELAXATION IN EXPANDING GAS FLOWS
K. N. C. Bray Sep. 1964 40 p refs
(AASU-260)

An extended sudden freezing technique is used to obtain approximate estimates of the effect of simultaneous atomic recombination and vibrational deexcitation in expanding gas flows. Active atoms and molecules are assumed to be carried in a large excess in inert gas, which is allowed to expand isentropically. The calculations make use of a simple chemical kinetic model, an important feature of which is the existence of a rate-limiting step between the upper and lower vibrational energy levels. A numerical example suggests that the coupling investigated here can lead to large increases in frozen vibrational and chemical energy in an expanding flow. Author

N65-17158# Cincinnati Univ., Ohio.
SCHLIEREN INVESTIGATION OF THE FLOW PHENOMENA ABOUT A TWO-DIMENSIONAL CIRCULAR CYLINDER IN A HYPERSONIC FLOW Interim Technical Report, Dec. 1962–Aug. 1963
K. H. Token and H. Oguro Wright-Patterson AFB, Ohio, ARL, Nov. 1964 48 p refs
(Contract AF 33(616)-8453)
(ARL-64-207; AD-610509)

Described is an experimental investigation of the fluid flow phenomena about a two-dimensional circular cylinder in a hypersonic stream. The data presented were accumulated solely through the use of the schlieren technique of flow visualization. The primary purpose of the investigation was to document the variation of the flow pattern with respect to flow parameters and models employed. As a result, the determination of specific problems for future investigation can be more adequately defined. Data concerning stagnation point shock layer thickness, bow shock-wave shape, secondary shock-wave shape, initial viscous wake growth, shear layer surrounding the base flow region, and intrinsic properties of the models and facility used are presented and discussed. All tests were conducted at a nominal free stream Mach number of 14, while the free stream Reynolds number was varied from 0.32×10^4 to 6.44×10^4. Author

N65-17183# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIAL-SLOTTED STREAM, FLOWING OUT FROM AN ANNULAR SOURCE OF FINITE DIAMETER
A. S. Ginevskiy 11 Jan. 1965 12 p refs Transl. into ENGLISH from Prom. Aerodinamika (Moscow), no. 23, 1962 p 72–79
(FTD-TT-64-601/1+2; AD-610323)

An approximate solution is given for an effluent laminar and turbulent stream from an annular source of finite radius. It is shown that when the radius of the annular source tends toward zero the solution obtained transforms into an asymptotic solution that is very close in numerical value to previously published solutions. Also, the method used in this paper can be applied to solving another problem, that of a radial-slotted internal stream, flowing from an annular source inward toward its axis of symmetry. The solution derived for this latter problem is valid in an area some distance from the axis of symmetry, where the streams do not collide, pressure gradients do not originate, and the flow does not become unstable. D.E.W.

N65-17195# Virginia Univ., Charlottesville. School of Engineering and Applied Science
PROJECT SQUID: A COOPERATIVE PROGRAM OF FUNDAMENTAL RESEARCH AS RELATED TO JET PROPULSION OFFICE OF NAVAL RESEARCH, DEPARTMENT OF THE NAVY Semiannual Progress Report, 1 Apr.–30 Sep. 1964
1 Oct. 1964 73 p refs
(Contract Nonr-3623(00); Proj. Squid)
(AD-607322)

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4. COMBUSTION PHENOMENA R. Friedman et al p 63–67 refs

N65-17212*# Wyle Labs., Inc., Huntsville, Ala.
AERODYNAMIC NOISE RESEARCH SUPPORT Quarterly Progress Report, Oct.–Dec. 1964
7 Jan. 1965 47 p refs
(Contract NAS8-11308)
(NASA-CR-60739) OTS: HC $2.00/MF $0.50

The equations governing the pressure fluctuations in a turbulent boundary layer are derived, following the known methods for incompressible flow. The case of the attached turbulent boundary layer is discussed, and the hypothesis advanced that the major cause of wall pressure fluctuations is the intermittent eruption of the laminar sublayer, which has been observed during flow visualization experiments. This hypothesis agrees with all the known features of boundary layer pressure fluctuations, and offers a good physical framework for the understanding of their actions. The case of the

separated turbulent boundary layer is then discussed. Application of the equations already derived shows how additional sources of pressure fluctuation may be present in the separated boundary layer compared to the attached case. Finally it is shown how the conventional turbulence–mean shear interaction gives rise to pressure patterns which are convected at only a fraction of the free stream velocity. This contradicts the presently available supersonic experimental results, and it is suggested that the new mechanisms of pressure fluctuation may be occurring in the supersonic separated flow case.
Author

N65-17243# California Univ., Los Angeles. Dept. of Engineering
AN EXPERIMENTAL STUDY OF LOW SPEED EDGETONES
Alan Powell and H. H. Unfried Nov. 1964 67 p refs
(Contract Nonr-233(62))
(UCLA-64-49; AD-610028)

This experimental investigation of low speed jet edgetones was performed in connection with the development of the acoustic feedback theory first presented in 1953. Two jet edgetone systems are described. With these systems, variations in the breadth of the stream, the angle of the wedge and the size of the wedge were made while measurements of edge distance, stream velocity, frequency, sound pressure level and the associated radiation pattern were performed, the exit velocity profile of the stream being controlled. The fluctuating force on the wedge was measured simultaneously with the far field acoustic pressure, and the results confirm that the acoustic far field can be represented by an equivalent point dipole located in the region of the wedge and whose magnitude corresponds to the measured force. Richardson's crucial experiment was repeated and the result is consistent with the feedback theory. The experimental results concerning such features as the number of stages, minimum edge distance, and the size and shape of the obstacle are all consistent with the acoustic feedback theory.
Author

N65-17282*# National Bureau of Standards, Boulder, Colo.
THE SURFACE TENSION OF HYDROGEN
R. B. Stewart, F. E. E. Germann, and R. D. Mc Carty 1 Oct. 1962 14 p refs
(NASA Order R-45; NBS Proj. 8140-40-81450)
(NASA-CR-50286; NBS-7616) OTS: HC $1.00/MF $0.50

This preliminary report presents values of surface tension for normal hydrogen and parahydrogen for temperatures from 14° to 33° K. The basis for the calculation of these data is provided by a correlation of reduced surface tension data for helium-3, helium-4, normal hydrogen, and normal deuterium with reduced temperatures, and by the selection of a suitable relation for the variation of surface tension with temperature.
Author

N65-17339# Kraichman (Robert H.), Peterborough, N. H.
KOLMOGOROV'S HYPOTHESES AND EULERIAN TURBULENCE THEORY
Robert H. Kraichman Jun. 1964 34 p refs
(Contract Nonr 4307(00))
(RR-6; AD-603628)

It is argued that Eulerian formulations are intrinsically unsuited for deriving the Kolmogorov theory because low-order Eulerian moments do not express sufficiently well a statistical dependence of nonsimultaneous amplitudes that accompanies the convection of small spatial scales by large spatial scales. Illustration is made by applying the direct-interaction approximation and a related, higher Eulerian approximation to an idealized convection problem and to a modified Navier–Stokes equation. Convection effects of low wave numbers on high wave numbers are removed in the modified equation, and as a consequence the direct-interaction approximation for it yields the Kolmogorov spectrum. Low-order Lagrangian moments provide a more complete description of the convection of small spatial scales by large, and a search for satisfactory Lagrangian closure approximations seems highly desirable.
Author

N65-17340# Kraichnan (Robert H.), Peterborough, N. H.
LAGRANGIAN-HISTORY CLOSURE APPROXIMATION FOR TURBULENCE
Robert H. Kraichnan Jul. 1964 53 p refs
(Contract Nonr-4307(00))
(RR-7; AD-603629) OTS: $3.00

The direct-interaction approximation for turbulence is extended to predict the covariance and average Green's function of a generalized velocity, $v(x,t|r)$, measured at time r in the fluid element which passes through the point x at time t. The resulting formulas for triple moments involve integrals over the Eulerian time history of the fluid. The approximation is then altered so that the integrals are over Lagrangian histories, measured along the particle paths. The alteration is made necessary and is uniquely determined by requiring simultaneously that energy be conserved, that there exist formal inviscid equipartition solutions, and that the dynamics exhibit invariance under a class of random Galilean transformations. In the altered approximation, the relaxation times associated with energy transfer are Lagrangian memory times determined by the viscous and pressure forces. As a result, the approximation yields the Kolmogorov inertial- and dissipation-range laws.
Author

N65-17350# California Univ., Berkeley. Inst. of Engineering Research
SHIP RESISTANCE IN UNIFORM WAVES
O. J. Sibul Jan. 1964 55 p refs
(Contract Nonr-222(18))
(NA-64-1; AD-606276)

Several ship models (Series 60: C_B = 0.60, 0.70, 0.80; and DE 1006) were tested in uniform waves. Motions, as well as resistances, were measured in more than 2500 individual tests. The ratios of wave length to ship length of 0.75, 1.00, 1.25, and 1.50 were covered. The wave steepness was varied between 1:15 and 1:70 for each of the wave lengths. The speed range for testing was between Froude numbers of 0 and 0.35. Still water resistances were measured in separate experiments, and the added resistance due to the oncoming waves was derived by subtracting the still-water resistance from the total resistance in waves. The results indicated that the added resistance (1) depends upon the block coefficient, the speed of the ship, and the steepness of the waves; (2) has a maximum in the vicinity of the maximum motions, and decreases again for the higher speeds; and (3) reaches higher values per unit displacement for smaller block coefficients.
Author

N65-17353# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL EFFECTS OF ACCOMPANYING FLOW OF GAS IN SHOCK TUBE
Yu. V. Makarov and Yu. A. Polyakov 26 Dec. 1963 10 p refs
Transl. into ENGLISH from Fiz. Gazodinam., Teploobmen i Termoddinamika Gazov Vysokikh Temperatur, Akad. Nauk SSSR, Energ. Inst. (Moscow), 1962 p 270–274
(FTD-MT-63-73; AD-605908)

During the passage of strong shock waves, a flow of thermal ionization gas will be formed behind the front. Processes of diffusion, developing in the front, can lead to large gradients of electric potential along the direction of propagation of the front which are very difficult to measure. Analogous processes of diffusion and thermal diffusion behind the shock front can, in the presence of walls, lead to the appearance of potential differences between the flow of ionized gas and the wall (gradient of potential in radial direction will not exist, due to high conductance of gas). An attempt is made to investigate this effect. Also, the flow of an ionized gas around a model with a blunt nose section is qualitatively investigated. Author

N65-17371# RAND Corp., Santa Monica, Calif.
THE INVERSE PROBLEM OF THE LINEARIZED THEORY OF FULLY-CAVITATING HYDROFOILS
B. R. Parkin Sep. 1964 65 p refs
(Contract AF 49(638)-700; Project RAND)
(RM-3566-PR; AD-606038)

This report presents the basic theory and some numerical results on the inverse problem for fully cavitating hydrofoils. The problem is treated by the two-dimensional linearized theory of steady cavity flows. The problem of optimum hydrodynamic design of cavitating blades or foils is explored and the conditions required to insure realistic cavity flows are examined. As a result of these considerations three methods for profile design are put forward. Two of these methods are treated numerically. It is found that once the pressure distribution has been prescribed, the shape of the profile depends upon the design cavitation number. The camber decreases as the cavitation number increases. Author

N65-17380# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
APPROXIMATE ANALYTICAL SOLUTION OF SIMILARITY BOUNDARY LAYER EQUATIONS WITH VARIABLE FLUID PROPERTIES
Nelson H. Kemp Sep. 1964 69 p refs
(Contract Nonr-1841(93); Grant AF-AFOSR-353-63)
(Publ.-64-6; AD-606870)

An approximate method of the integral type is developed for computing heat transfer and shear stress in similarity boundary-layer problems of single fluids with variable fluid properties. It is applied to flat-plate, stagnation-point, and shock-tube end-wall geometries. Simple analytical formulas are developed involving integrals over the fluid properties and these formulas are corrected by use of exact solutions of incompressible cases. When the corrected formulas are compared with exact solutions for power-law or combination of power-law fluid properties, agreement is found to within 3% to 5% for heat transfer rate and 4% to 8% for shear stress. It is shown that a simple relation exists between the heat transfer in the stagnation-point and end-wall cases, enabling bounds on the stagnation-point heat transfer rate to be found from calculations for the simple end-wall geometry. Author

N65-17388# Hydronautics, Inc., Laurel, Md.
SUPERCAVITATING PROPELLERS: HISTORY, OPERATING CHARACTERISTICS, MECHANISM OF OPERATION
Marshall P. Tulin 1 Jun. 1964 96 p refs
(Contracts NObs-84720; Nonr-3435(00))
(TR-127-6; AD-602473)

Definitions are given of four regimes of propeller operation: subcavitating, partially cavitating, supercavitating, and fully supercavitating. The arched shape of the fully supercavitating characteristic curve (k_t vs J) is described and explained. New phenomena—cavity blockage and blade-cavity interference—which dominate the mechanism of operation of supercavitating propellers are described. Some quantitative theoretical results relating to these phenomena are presented. It is explained how these phenomena account for effects on thrust and efficiency, observed experimentally, but not previously understood. Fundamental differences in the mechanism of operation of subcavitating and supercavitating propellers are revealed. Author

N65-17390# Iowa Inst. of Hydraulic Research, Iowa City.
A PRELIMINARY STUDY OF THE EFFECT OF THE FREE SURFACE ON THE DRAG OF A TRUNCATED 2:1 ELLIPSOID
Arthur D. Newsham Aug. 1964 12 p refs
(Contract Nonr-1509(05))
(AD-605582) OTS: $1.00

This phase of the study of the drag force on truncated, axisymmetric, supercavitating bodies near a free surface has involved the design, construction, and checking of the apparatus and instrumentation necessary to conduct the experiments. A truncated 2:1 ellipsoid at zero angle of yaw was chosen for the initial investigation. The drag of this body at zero angle of yaw has been measured and compared with existing data for a completely submerged 2:1 ellipsoid. In addition, some preliminary work concerning the effect of the proximity of the free surface has been performed. Author

N65-17398# Johns Hopkins Univ., Baltimore, Md. Mechanics Dept.
CHEMICAL REACTIONS IN HOMOGENEOUS TURBULENT FIELDS
S. Corrsin [1964] 12 p refs Presented at the AIAA Meeting, New York, 20 Jan. 1964 Sponsored by ONR
(AD-607993) OTS: $1.00

If the homogeneous turbulent mixing of a passive, scalar contaminant is statistically known, the differences resulting from incorporating chemical reactions need to be known. The long range goal is turbulent combustion, in which the large (random) heat release probably feeds back into the fluid dynamics. A beginning is made with the simplest conceivable mathematical models, and passive mixing problems to which simple reaction terms are added. The outline touches on two classes of problems: (1) estimates of decay rates of average concentrations and isotropic concentration fluctuations; and (2) estimates of the forms of Fourier power spectra for locally isotropic, statistically stationary fields. Three idealized, irreversible, passive, chemical reaction types are mentioned: (a) first-order, isothermal, (b) second-order, isothermal, and (c) first order, slightly exothermic. The spectral estimates employ a generalization of Onsager's turbulence cascade theory. Author

N65-17430# AVCO-Everett Research Lab., Everett, Mass.
THE RAPID EXPANSION OF A SUPERSONIC SHEAR FLOW
Sheldon Weinbaum Jan. 1965 48 p refs Prepared for Bell Telephone Labs.
(Contracts DA-30-069-ORD-1955; DA-19-020-AMC-0210; AF 04(694)-414; Proj. Defender)
(AVCO-Everett Res. Rept.-204; BSD-TDR-64-163; AD-456987)

In examining the behavior of a supersonic shear flow undergoing a rapid expansion, it is shown that a small region of highly rotational flow subject to large accelerations can significantly alter distant free stream conditions. In particular, the presence of a supersonic boundary layer can cause the centered expansion of the uniform flow outside the boundary layer to depart severely from the Prandtl–Meyer theory. At high external Mach numbers, $M_e > 8$, less than half the

total free stream expansion occurs in the centered expansion at the corner; the reflected wave system downstream of the corner produces the remainder and is, therefore, the principle mechanism for pressure changes. For weak expansion fans, $\theta < 10$ degrees, an inviscid second-order theory is developed which treats the original centered waves in a nonlinear manner but linearizes the strengths of the reflected waves. For large angle expansions rotational characteristic solutions are presented for representative laminar and turbulent boundary layer shear profiles. Author

N65-17431# Aerospace Corp., San Bernardino, Calif. Re-Entry Fluid Dynamics Dept.

A GENERAL NUMERICAL METHOD OF CHARACTERISTICS

H. Sauerwein Dec. 1964 55 p refs

(Contract AF 04(695)-469)

(TDR-469(S5855-80)-1; BSD-TR-64-182; AD-457051)

Characteristics of magnetofluid dynamics problems and ordinary fluid dynamics are described. The method can be applied to unsteady three-dimensional flows of chemically reacting nonequilibrium multicomponent media. Viscosity, heat conduction, and diffusion must be negligible and electrical resistance must be either negligible or infinite to apply the method. These dissipative phenomena must be neglected to make the governing equations of change hyperbolic because the method can be applied only to quasi-linear hyperbolic partial differential equations. Practical restrictions on computation time usually require unsteady problems to be limited to the hypersonic speed range although theoretically the method applies to all unsteady flows. The characteristic and compatibility equations are derived by first considering a simple one-dimensional unsteady case and progressing to the most general case in simple stages. The finite difference network and its corresponding equations are developed in a similar fashion. The specialization of the general method to consider simpler problems is outlined. The practicality and feasibility of utilizing the general numerical method of characteristics on presently available electronic digital computers is evaluated in the light of recent experience in calculating multidimensional flows with the method. Author

N65-17437# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.

INCOMPRESSIBLE MOMENTUM INTEGRAL BOUNDARY LAYER SOLUTION RELATING TO SHOCK TUBE TEST TIME

H. Mirels and W. S. King 29 Dec. 1964 46 p refs

(Contract AF 04(695)-469)

(TDR-469(5240-10)-3; SSD-TDR-64-275; AD-456714)

The incompressible laminar boundary layer in the entrance region of a semi-infinite tube, with a moving wall, was investigated by the use of a Karman–Pohlhausen momentum integral method with a quartic velocity profile. Numerical solutions were obtained for $W \geq 2$, while an analytical solution was obtained for $W^{-2} << 1$ (where $W \equiv u_w/u_{e,0}$ is the ratio of wall velocity to the free-stream velocity at the entrance). For $W > 1$, the free-stream velocity becomes zero in a length x_f which corresponds to the limiting separation distance in a shock tube. The incompressible local similarity estimates for x_f were higher than the incompressible momentum integral estimates by about 30% at $W = 5$ and about 15% at $W = 10$. The momentum integral solution is expected to be more accurate. Therefore, the local similarity method, previously used by Mirels, appears to overestimate shock tube test time for moderate values of W. An improved solution, for test time, is in progress. Author

N65-17439# California Univ., Berkeley. Inst. of Engineering Research

NEARLY FREE MOLECULAR FLOW: A COMPARISON OF THEORY AND EXPERIMENT

F. S. Sherman, D. R. Willis, and G. J. Maslach 15 Oct. 1964 24 p refs Presented at the 11th Intern. Congr. for Appl. Mech., Munich, 30 Aug.–5 Sep. 1964

(Contract Nonr-222(45))

(AS-64-16; AD-456356)

Measured drag coefficients for cylinders, normal strips, and spheres in nearly free-molecular flow at M = 6, 8 and 10 are correlated with a collision-rate parameter suggested by the modified Krook model, and are compared with theoretical estimates based on a variety of kinetic models and methods of analysis. The comparison of theory and experiment and the comparative effectiveness of various rarefaction parameters are discussed, and suggestions for further experimentation are made. Author

N65-17440# California Univ., Berkeley. Inst. of Engineering Research

THE MEASUREMENT OF BASE PRESSURE ON WEDGES IN SUPERSONIC LOW DENSITY FLOW

R. T-S. Cheng, S. A. Schaaf, and F. C. Hurlbut 30 Nov. 1964 26 p refs

(Contract Nonr-222(45))

(AS-64-17; AD-456366)

Base pressure measurements on two-dimensional wedges were carried out at nominal Mach numbers of 4 and 6 and free-stream Reynolds numbers from 840 to 8600. A cathetometer was used to measure the height difference of the oil surfaces of a small U-tube manometer mounted within the wind tunnel. Both span-wise and cross-base distributions of the base pressures were measured. The experiments proved that the arrangement adopted performed satisfactorily within the required degree of accuracy. Author

N65-17441# California Univ., Berkeley. Inst. of Engineering Research

HIGHER ORDER SLIP ACCORDING TO THE LINEARIZED BOLTZMANN EQUATION

C. Cercignani Dec. 1964 33 p refs

(Contract Nonr-222(45))

(AS-64-19; AD-456553)

A systematic approach to the problem of the boundary conditions matching the conservation equations in the Hilbert or Chapman–Enskog procedures is given. Quantitative estimates are also given by using the Bhatnagar, Gross and Krook model; in particular, the second order slip coefficient is evaluated. The results are applied to cylindrical Poiseuille flow, and the calculated flow rate is compared with experimental data. Author

N65-17473# Texas Western Coll., El Paso. Schellenger Research Labs.

REDUCTION OF MICROPHONE WIND NOISE BY THE GENERATION OF A PROPER TURBULENT FLOW

Harold N. Ballard and Mike Izquierdo Feb. 1965 24 p refs

(Contract DA-36-039-AMC-03218(E))

(ERDA-262; AD-455966)

A detailed theoretical and experimental study was made of the acoustic and noise-reducing characteristics of a modified line microphone which is an outgrowth of the noise-reducing line microphone of Daniels. The information gained from this study, coupled with the theoretical implications of the Navier–Stokes equation for fluid flows at large and small Reynolds

numbers, and a consideration of the velocity-gradient-dependent nature of the viscous forces acting within a fluid, led to use of a new concept to reduce the flow speed of the airstream over the microphone system. This is accomplished by the use of a screening device which creates a turbulent flow of the proper characteristics so as to dissipate the flow energy of the airstream without interfering with the reception of the desired acoustic signals. Wind tunnel and field test records are presented which indicate that the underlying basic concept is correct. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-16345*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELECTRONPROBE ANALYSES OF NICKEL DIFFUSION GRADIENTS IN IRON METEORITES AND THE COOLING HISTORY OF THE METEORITE PARENT-BODIES

James M. Short and Christian A. Andersen (Applied Research Labs.) [1964] 46 p refs

(NASA-TM-X-54981) OTS: HC $2.00/MF $0.50

Compositional variations in nickel, iron, and cobalt in nine octahedrites were determined by electron microprobe X-ray analysis. The steep gradients in taenite extending up to 35 to 50 wt% Ni and the shallow decreases (0.2-1 wt% Ni) in kamacite near the interface of the kamacite and taenite phases were formed during the final stage of formation of the Widmanstatten structure as cooling prevented attainment of equilibrium by diffusion. A simplified theoretical model based on the Fe–Ni system was used to relate the extent of diffusion to cooling rates of the meteorite parent-bodies. These depend critically on assumptions concerning the nucleation temperatures of kamacite, pressure, phase equilibria, and cooling model. Metallurgical evidence implies that nucleation of kamacite may not have occurred at the $\gamma/\alpha + \gamma$ boundary in the Fe-Ni system, but after undercooling of about 100° C at 1 atmosphere pressure. The α_2 nuclei may have initiated diffusion growth of kamacite which ceased by 350° C. Differing nucleation temperatures account for meteorites of different structure, but of identical nickel content for a range of kamacite bandwidths and for coarse plessite. Author

N65-16434*# Illinois Univ., Urbana.

F-REGION IRREGULARITIES STUDIED BY SCINTILLATION OF SIGNALS FROM SATELLITES

K. C. Yeh and G. W. Swenson, Jr. [1963] 59 p refs

(Grant NsG-24-59)

(NASA-CR-53493) OTS: HC $3.00/MF $0.50

Scintillation of radio signals from earth satellites was studied for 5 years during the declining phase of the sunspot cycle. It was found that the character of the scintillation, and thus, probably, of the ionospheric irregularities that cause it, varies systematically with geomagnetic latitude, season of the year, time of day, and phase of the sunspot cycle. Nighttime scintillation occurs in the F-region, mainly at heights of about 350 km. This type of scintillation in most cases results from first-order scattering from weak, field-aligned irregularities in electron density, which may be caused by two-stream instabilities excited by dumping of electrons from the earth's radiation belts. Such scintillations are observed north of a certain parallel of geomagnetic latitude, the southern limit varying weakly with magnetic activity. Similar effects are observed in both Northern and Southern Hemispheres. Correlations of scintillation with other manifestations of ionospheric disturbances, including spread-F, red auroral arcs, magnetic activity and corpuscular counts, in the outer radiation belt, were noted, and support the presumed association with leakage of electrons from the belt. Scintillation occurs much more frequently than any of these other phenomena, and may provide a more sensitive indication of the dumping process. Author

N65-16572# Ohio State Univ. Research Foundation, Columbus.

THERMAL RADIATION METHODS OF ATMOSPHERIC PROBING Scientific Report No. 6 (Final), 1 Mar. 1960–30 Nov. 1964

H. H. Nielsen, J. Shaw, L. L. Abels, and D. Ford Nov. 1964 110 p refs

(Contract AF 19(604)-6141)

(AFCRL-64-984; AD-456023)

A review of completed studies is presented, together with reprints of some of the published papers, and includes studies of pressure modulation of infrared emission and absorption spectra, dependence of total band absorptance on the physical conditions of the absorbing gas, infrared fluorescence of carbon monoxide, design of infrared satellite instrumentation, and absorption by atmospheric gases in solar spectra. Three principal investigations currently in progress are described and include measurement of individual line widths and strengths of the 1-0 band of NO near 5.3μ, the investigation of the dependence of the total absorptance of this NO band on total pressure and NO concentration, and a study of the dependence of the total absorptance of the 4.75μ bands of O_3 on total pressure and O_3 concentration. D.S.G.

N65-16577* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DIFFUSION OF AURORAL ELECTRONS IN THE ATMOSPHERE

Kaichi Maeda Washington, NASA, Feb. 1965 26 p refs

(NASA-TN-D-2612) OTS: HC $2.00/MF $0.50

The results of a Monte Carlo computer program to treat electron reflection and transmission by plane-parallel slabs were applied to the diffusion of monoenergetic auroral electrons in the polar atmosphere. The following conclusions were reached: (1) The straggling effect is significant for electrons with energies above 20 keV, but is negligible below 10 keV. (2) Back scattering decreases at both high and low energy levels, showing a maximum around 20 keV. The back-scattering coefficient at the maximum level is on the order of 7% (intensity) and 4% (energy flux) for vertical incidence, and 20% and 15% respectively, for isotropic incidence. (3) Angular distribution of penetrating electrons approaches perfect diffusion with cosine-squared rather than gaussian distribution around half of the penetration (back-diffusion) depth for both vertical and isotropic incident distribution. Also, previous calculations on penetration depth and effective depth of energy distribution are shown to have been greatly underestimated for electron energies above 20 keV, because of the straggling effect. Author

N65-16596*# National Aeronautics and Space Administration. Washington, D. C.

HEATING OF THE EARTH'S INTERIOR DURING THE EARTH'S FORMATION [O NAGREVANII ZEMNYKH NEDR V PROTSESSE OBRAZOVANIYA ZEMLI]

Ye. A. Lyubimova Feb. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 5, 1955 p 416–424
(NASA-TT-F-309) OTS: HC $1.00/MF $0.50

This report considers the initial temperature of the earth when it was formed by coalescence of the cold particles of the gas-dust protoplanetary cloud, estimates the rise in temperature during the compression of the material under the pressure of layers growing outwardly, and shows that the maximum initial temperature of 800° to 2400° K was reached at a distance of about 0.6 earth radii from the center of the earth. The question of the initial temperature of the earth's core requires further study. Author

N65-16599*# Consultants and Designers, Inc., Arlington, Va.
ABSORPTION IN THE ATMOSPHERE OF RADIO EMISSION AT 70.16 CM WAVELENGTH [POGLOSHCHENIYE RADIOIZLUCHENIYA NA VOLNE 70.16 CM V ATMOSFERE]
D. A. Dmitrenko, V. D. Krotikov, V. S. Troitskiy, and N. M. Tseytlin 12 Feb. 1965 9 p refs Transl. into ENGLISH from Izv. Vyssh. Uchebn. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 5, 1964 p 817–821
(Contract NAS5-3760)
(NASA-TT-F-9641; ST-RWP-AI-10289) OTS: HC $1.00/MF $0.50

The results are given of absorption in the atmosphere derived from measurements of its proper radio emission at 70.16-cm wavelength. The optical thickness of the atmosphere along the vertical was found to be $9.2 \cdot 10^{-3} \pm 15\%$. Author

N65-16707# Royal Aircraft Establishment, Farnborough (England).
AN INTRODUCTION TO SOME EARTH MAGNETIC FIELD MEASUREMENTS AT VARIOUS ALTITUDES
M. J. Downey Sep. 1964 22 p refs
(RAE-TR-64008)

This report serves as an introduction to the study of the earth's magnetic field and its variations. Preliminary satellite measurements at different altitudes are described and correlated with theoretical data. Author

N65-16711# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR MAY 1964 FROM WOOMERA, SOUTH AUSTRALIA Ionospheric Data Bulletin
Oct. 1964 24 p
(CPD-1964/5(W))

This bulletin is one of a monthly series containing tabulations of ionospheric data obtained from a station at Woomera, South Australia, located at 30.8° S and 136.3° E. Characteristics of the ionosonde are also given. D.S.G.

N65-16712# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR JUNE 1964 FROM WOOMERA, SOUTH AUSTRALIA Ionospheric Data Bulletin
Oct. 1964 28 p
(CPD-1964/6(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for June 1964. Author

N65-16743# Naval Oceanographic Office, Washington, D. C. Oceanographic Prediction Div.
REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM, 1961 Tenth Annual Report
Denys W. Knoll Dec. 1964 178 p
(SP-70(61)) Available from Naval Oceanog. Office: $1.85

A summary of NAVOCEANO and Danish ice operations during 1961 is presented. Operational aspects of obtaining and disseminating ice information and the ice forecasting and observing program are discussed. Ice charts depict observed synoptic ice conditions throughout the year. Locations of oceanographic stations occupied in the polar and subpolar regions are included. Author

N65-16778 Travelers Research Center, Inc., Hartford, Conn.
FURTHER INVESTIGATIONS OF NUMERICAL MODELS OF THE ATMOSPHERE BOUNDARY LAYER Final Report
Joseph P. Pandolfo, Duane S. Cooley, and Marshall A. Atwater Jul. 1964 112 p refs
(Contract Cwb-10682)
(Rept.-7458-126; AD-608627) OTS: $4.00

In an extension of previous work, a combined diffusion-surface heat balance model for the atmospheric planetary boundary layer has been programed for numerical integration, and has undergone preliminary testing with data from seven 6-hour test periods selected from the observational program. The tests show that the inclusion of the surface heat exchange process eliminates the necessity for prespecification of a lower boundary temperature in order to obtain realistic predictions of temperature and wind trends in the presence of cloudiness. Some modifications of the present modeled maximum and minimum values of exchange coefficient are suggested by the results. Model equations for the computation of radiative flux divergence effects in the presence of boundary layer clouds were derived. Detailed program specifications are presented for the computation of latent heat effects due to the presence of suspended liquid water in the boundary layer. Equations for the computation of the mean vertical velocity and three-dimensional advective change were also derived. Author

N65-16800# Aeronautical Chart and Information Center, St. Louis, Mo. Geophysical and Space Sciences Branch
CLASSICAL METHODS FOR REDUCTION OF GRAVITY OBSERVATIONS
Donald M. Scheibe and Harold W. Howard Apr. 1964 98 p refs
(ACIC-Publ.-12; AD-608597)

There are many methods for the reduction of gravity observations, each with its limitations. This report discusses the most popular classical reductions, viz, free air, condensation, inversion, Bouguer, and isostatic, to develop a background of theoretical knowledge. The procedures for the reduction of gravity measurements and the determination of anomalies using the free-air, Bouguer, and Airy–Heiskanen isostatic techniques are presented. Author

N65-16817# Navy Electronics Lab., San Diego, Calif. Listening Div.
PROBABILITY DENSITY ANALYSIS OF OCEAN AMBIENT AND SHIP NOISE
M. A. Calderon 5 Nov. 1964 48 p refs
(NEL-1248; AD-453987)

Ambient ocean noise was found to have a Gaussian distribution of amplitudes (in the sense that the moments of the distribution satisfied specific tests) only when the ambient noise was relatively clean; i.e., the noise did not contain high level ship noise, biological noise, ice noise or any of the other extraneous noises. The group of ship-noise samples recorded at close range contained a large number of samples that had a non-Gaussian distribution. However, the other types of extraneous noises were found to cause the same kind of deviation from a Gaussian distribution, so that it was not

possible by these tests to distinguish between a sample with ship noise and a sample with the other types of extraneous noises (such as biological and ice noise). Author

N65-16898# Woods Hole Oceanographic Institution, Mass.
HEAT FLUX AND SURFACE STRESS ON AND NEAR AN ISLAND IN THE TRADE WIND REGION Semiannual Progress Report, Dec. 5, 1963–Jun. 30, 1964
E. B. Kraus [1964] 94 p refs
(Contract DA-36-039-SC-90784)
(SAPR-4; AD-452121)

The work of the Woods Hole party which cooperated with a canadian group, on board the H. V. Baffin in the vicinity of Aruba, N. A., is discussed. Preliminary results are shown, and the spray observation program during the Aruba expedition is described. The wave recorder built for the present work, and the performance of the Woods Hole stable meteorological buoy are discussed. Differences in the mechanism of momentum transfer over land and sea are considered. Author

N65-16926# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics
ROSSBY WAVES IN A BAROCLINIC, COMPRESSIBLE ATMOSPHERE
Robert R. Long Nov. 1964 19 p refs
(Contracts Nonr-4010(01); CWB-10917)
(ONR-TR-19; CWB-TR-22; AD-608561)

The equation is solved for steady, finite disturbances in a uniform basic current, and the results are compared with finite-amplitude Rossby waves in an incompressible, homogeneous fluid. It is found that if the vertical velocities are identically zero, neither the baroclinicity nor the compressibility has any effect. When vertical motion is allowed, the speed of the waves is strongly affected by the baroclinicity but quite unaffected by the compressibility. The wave speed relative to the resting fluid is about 25% less than the Rossby wave speed when the vertical velocity is of one sign along a vertical. The problem is solved completely in two cases, an incompressible atmosphere, and a fluid with compressibility properties similar to those of air. Both compressibility and baroclinicity have important quantitative effects. Author

N65-16940# Royal Aircraft Establishment, Farnborough (England).
THE VARIATION OF UPPER-ATMOSPHERE DENSITY BETWEEN SUNSPOT MAXIMUM (1957-8) AND MINIMUM (1964)
D. G. King-Hele and Eileen Quinn London, Min. of Aviation, Aug. 1964 19 p refs
(RAE-TN-Space-72)

Values of air density at heights from 200 to 800 km, obtained from the contraction rate of the orbits of 46 satellites, were used to derive a total of 146 values at dates between 1957 and 1964. The results show the great decrease in density as solar activity declined during this time interval: At 500-km height, for example, the daytime density was 15 times greater in 1958 than in 1964. The amplitude of the variation in density between day and night is also charted throughout the half cycle of solar activity: In 1964 at 500-km height, for example, the maximum daytime density is 4 times greater than the minimum nighttime density. Author

N65-16945# Virginia Inst. of Marine Science, Gloucester Point.
SHELF OBSERVATIONS—HYDROGRAPHY CRUISE OF AUGUST 21–26, 1962
M. M. Nichols and R. C. Barnes Feb. 1964 25 p *Its* Spec. Sci. Rept. No. 41

Hydrographic observations were made on the continental shelf east of the mouth of Chesapeake Bay to investigate physical and chemical characteristics of shelf water. Stations were established at 10-mile intervals along traverses 20 miles apart. On the outer shelf, stations were placed 3 to 5 miles apart to obtain greater detail. Observations included vertical profiles at fixed stations and track measurements of surface water. Temperature and salinity were measured in situ with various instruments; surface and bottom water samples were obtained; chlorinity was determined by standard silver nitrate titrations with conversion calculations; and oxygen concentrations were determined by the Winkler method. Drift bottles and Woodhead bottom drifters were released in groups of six at the fixed stations. The distributions of measured parameters are presented in figures and tables, and their interpretations are given with brief discussions. D.E.W.

N65-16969# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
SURFACE WIND SAMPLING FOR UNGUIDED ROCKET IMPACT PREDICTION
Henry Rachele and Daniel R. Veith Jan. 1965 59 p refs
(ERDA-255; AD-456795)

Results show that samples several minutes long, taken at the observation site, provide better estimates of the wind at the launch pad than do instantaneous values. This is particularly true if the delay time is as much as 3 minutes, and the wind measurements are not up or downwind of the launcher. The most significant result is that regardless of sample time up to 3 minutes, the space–time variance increases rather rapidly as a function of delay time up to approximately 5 minutes. Author

N65-17027# Bureau des Longitudes, Paris (France).
AIR ALMANAC, JANUARY THROUGH APRIL, 1965 [EPHEMERIDES AERONAUTIQUES, JANVIER A AVRIL, 1965]
[1965] 319 p In FRENCH

Daily tables furnish the necessary information for determination of aircraft position by navigational methods. Use of the ephemeris is explained. R.L.K.

N65-17047# Stanford Univ., Calif. Radioscience Lab.
STUDY OF NATURAL AND MAN-MADE VLF PHENOMENA Final Report, 1 Aug. 1963–31 Jul. 1964
D. L. Carpenter Oct. 1964 16 p refs
(Grant AF-AFOSR-62-370)
(AFOSR-64-2067; AD-608595)

Work is reviewed on whistler-mode propagation, magnetospheric electron density studies using whistlers, and wave–particle interactions. The research on whistler-mode propagation included two areas: the detection of ionic resonances in satellites, and an FM technique for observing vlf whistler-mode propagation. Magnetospheric electron density measurements are discussed in a review of the whistler method, a study of the field line distribution of electrons, an electron density analysis based on vlf emissions. Observations on wave–particle interactions are described in short discussions of multiphase periodic vlf emissions, of the relation between periodic emissions and whistler mode propagation, and of the association between vlf emissions and the flickering aurora. Theoretical studies of wave–particle interactions covered vlf emission generation mechanisms, high latitude vlf radio emission

generated in the ionosphere, whistler propagation in a thermal magnetosphere, wave–particle gyroresonance interactions in the earth's outer ionosphere, direct traveling wave amplification of whistler mode signals by a gyrating electron stream, and the diurnal variation of chorus. D.E.W.

N65-17204# American Science and Engineering, Inc., Cambridge, Mass.
THE GENERATION OF INFRARED RADIATION IN THE UPPER ATMOSPHERE BY CHEMICAL SEEDING Final Report, Part II
Louis E. Ashley Aug. 1964 45 p refs
(Contract AF 19(604)-8463)
(ASE-711; AFCRL-64-849(II); AD-610735)

An assessment was made of the feasibility of generating infrared radiation at high altitudes by chemical means. The various chemical species present in the ionosphere were examined, and an estimate was made of the total energy that could be obtained through their interactions. Practical conversion of this energy into infrared radiation by means of chemical catalysis was considered and a method by which this may be carried out was evaluated. The results of this evaluation indicate the direction in which any further investigations might well be conducted. Author

N65-17220*# AVCO-Everett Research Lab., Everett, Mass.
THE TAIL OF THE MAGNETOSPHERE
W. I. Axford, H. E. Petschek, and G. L. Sisooe Dec. 1964 16 p refs revised
(Contract NASw-837)
(NASA-CR-60745; AVCO-Everett Res. Rept.-190(R)) OTS: HC $1.00/MF $0.50

The Chapman and Ferraro model of the magnetosphere is entirely dissipationless, and as a consequence contains no tangential stress at the magnetosphere boundary. It was suggested that either viscous interaction or reconnection of field lines can give rise to tangential stresses which produce internal convection within the magnetosphere. A number of auroral and ionospheric observations appear to be consistent with such a convection pattern. It was suggested that tangential stresses might stretch the magnetosphere tail and thus account for the main phase of magnetic storms. It is observed that recent measurements related to the magnetosphere tail lend further support to the suggestion that tangential stresses play a significant role. The observations of a strong magnetic field in the tail alined radially from the earth, the departures of the magnetic field from the Finch and Leaton Field in the neighborhood of 5 to 12 earth radii in the antisolar direction, the existence of particle fluxes in the tail, the latitude of the boundary of trapped particles as well as its day–night asymmetry and the low energy cosmic ray cutoff are all consistent. It appears that the tail provides a specific mechanism for injection of energy into the body of the magnetosphere. Author

N65-17268*# Consultants and Designers, Inc., Arlington, Va.
FREE ORGANIC RADICALS IN THE MIGHEI AND NOGOYA METEORITES [RADICAUX LIBRES ORGANIQUES DANS LES METEORITES MIGHEI ET NOGOYA]
Jules Duchesne, Joseph Depireux, and Clothilde Litt 22 Feb. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Cosmichimie (Paris), v. 259, no. 10, 21 Dec. 1964 p 4776–4778
(Contract NAS5-3760)
(NASA-TT-F-9646; ST-CC-10296) OTS: HC $1.00/MF $0.50

The electronic paramagnetic resonance signals connected with the free radicals present in the Mighei and Nogoya meteorite are studied. It is shown that these meteorites are characterized by a g = 2.002, comparable with that of lignites and coals. The high concentration in paramagnetic centers of the Mighei meteorite, 10^{17} per gram of carbonized matter, is further evidence of the validity of a previously proposed analogy. A discussion about the width of the observed signals suggests that the carbonized chondrites were not subjected to temperatures higher than 300° to 400° C. This is in complete agreement with the recent results obtained by Schulz and Elofson. The generality in the analogy with the behavior of coals is discussed, and it brings an additional presumption in favor of an extraterrestrial biogenic activity. Author

N65-17285*# RAND Corp., Santa Monica, Calif.
THE NON-CYCLIC VARIATION DURING QUIET DAYS
Albert T. Price (Exeter Univ.) Aug. 1963 18 p refs Submitted for Publication
(Contract NASr-21)
(NASA-CR-51578; P-2759) OTS: HC $1.00/MF $0.50

New methods of studying Sq during the IGY have revealed a clear pattern of the noncyclic variation field which was not discernible from earlier studies. The field is mainly zonal about the geomagnetic axis, though there are significant departures from axial symmetry. The zonal part corresponds closely to a uniform field plus a dipole field along the geomagnetic axis. The relative values of these two parts accord well with the assumption that the internal part arises from currents induced in the earth by Dst variations. The relationship between the noncyclic variations and hourly values of equatorial Dst is discussed. Author

N65-17298*# National Aeronautics and Space Administration, Washington, D. C.
BY THE WILL OF MAN. "CHAIN" REACTIONS IN THE GEOGRAPHICAL ENVIRONMENT AND THE TRANSFORMATION OF NATURE [PO VOLE CHELOVEKA. 'TSEPNYYE' REAKTSII V GEOGRAFICHESKOY SREDE I PREOBRAZOVANIYE PRIRODY]
I. Yu. Dolgushin Feb. 1965 36 p ref Transl. into ENGLISH from Priroda (Moscow), no. 11, 1964 p 10–22
(NASA-TT-F-9255) OTS: HC $2.00/MF $0.50

The advantages man can obtain from transforming nature are well known. Therefore, it is natural that the construction of irrigation canals, reservoirs, the reclamation of bole, and the restoration of forests consume hundreds of millions of rubles in Russia alone. Author

N65-17300*# Consultants and Designers, Inc., Arlington, Va.
THE CURVE OF GROWTH FOR ATMOSPHERIC ABSORPTION BANDS OF MOLECULAR OXYGEN [KRIVAYA ROSTA DLYA ATMOSFERNYKH POLOS POGLOSHCHENIYA MOLEKULYARNOGO KISLORODA]
A. S. Tibilov and V. K. Prokof'yev 18 Feb. 1965 13 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 32, 1964 p 3–10
(Contract NAS5-3760)
(NASA-TT-F-9644; ST-ACH-10294) OTS: HC $1.00/MF $0.50

Laboratory absorption spectra were obtained of the A- and B-bands of molecular oxygen in the 6900 to 7600 Å region of the spectrum, the path length being 236 and 77 m. The equivalent widths of 48 lines of the A-band and 23 lines of the B-band were measured. The curves of growth were obtained and the constants, derived from them, are in good agreement with the Allen data on the telluric bands in the solar spectrum. The effect of pressure, of the kind of expanding gas, and of temperature on the curve of growth are discussed. Author

N65-17305# Alaska Univ., College. Geophysical Inst.
GEOPHYSICAL INSTITUTE ANNUAL REPORT, 1963–64
[1964] 108 p

General review of status, facilities, and educational responsibility of the Geophysical Institute, University of Alaska, is presented. Reports on research, publications, Alaskan earthquake of March 1964, future programs, staff, and finance are included. The seismology program has been started and the meteorological investigations have been considerably extended. These, along with an intensification of the effort in aeronomy in the interest of the IQSY and the successful firing of the first series of rockets at Fort Churchill, provided the highlights of the Geophysical Institute's research progress during the year. E.E.B.

N65-17404*# Stanford Research Inst., Menlo Park, Calif.
LIGHTNING OBSERVATIONS FROM SATELLITES Final Report
Arnett S. Dennis Dec. 1964 94 p refs
(Contract NASr-49(18); SRI Proj. 4877)
(NASA-CR-60806) OTS: HC $3.00/MF $0.75

The feasibility of observing lightning from satellites is examined in the light of the effects produced at satellite heights by a lightning flash and of the statistics of lightning occurrences. A sferics detector operating around 600 Mc could be used on a low-orbit satellite at, e.g., 1000 km, but could not be used on a satellite in a stationary orbit (at 37 000 km) because of the low signal-to-noise ratio. The short-period variability in flashing rates imposes a lower limit of about 20 flashes per resolution element per observation. This requirement, examined in the light of typical flashing rates and the mechanics of satellite orbits, limits the spatial resolution of the optimum sferics satellite to some 150 km. To realize such resolution without the acceptance of severe limitations upon coverage, it would be necessary to use direction-finding equipment, capable of watching several resolution elements simultaneously. For an elementary system using a fixed antenna, 1000-km resolution would be more appropriate. The potential value of lightning observations from satellites in the fields of meteorology, climatology, atmospheric electricity, geophysics, and radio engineering is examined. It is concluded that such observations would be of some value in radio-noise studies but that their impact upon the other fields would be very slight. Author

N65-17411# American Association of Petroleum Geologists, Inc., Midland, Tex.
RADIOACTIVE WASTE-DISPOSAL POTENTIALS IN SELECTED GEOLOGIC BASINS A Reconnaisance Study
John E. Galley 26 Jun. 1964 46 p refs
(Contract AT(04-3)-413)
(SAN-413-2) OTS: $2.00

The importance of deep permeable geological disposal formations was studied for their feasibility to receive low, medium, and high radioactive waste in the regions of the Appalachian Basin, Michigan Basin, Salina Basin, Denver Basin, San Juan Basin, and the Valley and Ridge Province along the eastern edge of the Appalachian Basin. The first three sites contain basal sandstone layers that allow deep injection of low-level liquid nuclear wastes, and at the same time contain salt deposits as well as shale reservoirs suitable for disposal of high level radioactive waste and medium-level nuclear waste, respectively. These conditions should be considered in the selection of future nuclear plant sites. G.G.

N65-17466*# National Aeronautics and Space Administration, Washington, D. C.
INTENSITY-ALTITUDE DISTRIBUTION OF THE PRINCIPAL EMISSION LINES OF THE NIGHT SKY [RASPREDELENIYE PO VYSOTE INTENSIVNOSTI IZLUCHENIYA OSNOVNYKH EMISSIONNYKH LINIY NOCHNOGO NEBA]
T. M. Tarasova and V. A. Slepova Mar. 1965 15 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 2, 1964 p 321–327
(NASA-TT-F-9268) OTS: HC $1.00/MF $0.50

The emission lines of the night sky (nightglow) are investigated including those of atomic and molecular oxygen, sodium, hydroxyl, as well as the continuous spectrum in the λ 5300 Å region. It is shown that for the λ 5577, λ 8650 Å lines and OH band (λ 9100 to 10 700 Å), the luminescence is concentrated in relatively shallow layers 20 to 30 km thick with centers of gravity at altitudes of 90, 81, and 78 km, respectively. Data are correlated for different orientations of the recording instrument, permitting disclosure of luminescence at altitudes above and below 200 km for the lines λ 6300 and λ 5893 Å. For the continuous background of the night sky, a slow decay in intensity with altitude is established, with no clearly pronounced layered structure. Author

N65-17481# Isotopes, Inc., Westwood, N. J.
PROJECT STAR DUST: FLIGHT DATA AND RESULTS OF RADIOCHEMICAL ANALYSES OF FILTER SAMPLES COLLECTED DURING 1961 AND 1962 Appendix to The Tenth Progress Report
Herbert W. Freeiy; James P. Friend, Philip W. Krey, and Barbara A. Russell New York, AEC, Health and Safety Lab., 1 Jan. 1965 221 p
(Contract DA-49-146-XZ-079)
(HASL-153) OTS: $3.00

Work performed during Project Star Dust is directed toward the development of a model of atmospheric transport processes that will describe the mixing and transfer of trace materials in the stratosphere and upper atmosphere. A program of collection and radiochemical analysis of filter samples of stratospheric and tropospheric air is described that will provide the basic data needed for the formulation of the model. Flight data for all usable samples and results of radiochemical analysis of the samples are presented. The samples were divided into four groups; the first group was analyzed for Sr^{89}, Zr^{95}, Ce^{141}, Ce^{144}, and Ba^{140}; the second group, for Mn^{54}, Fe^{55}, Sb^{124}, and Cd^{109}; the third group, for Be^{7}, lead^{210}, Po^{210}, W^{181}, and Rh^{102}; and the last group, for Cs^{137} and Pu^{239}. All groups were analyzed for Sr^{90}. D.S.G.

N65-17484# Atomic Energy Commission, New York. Health and Safety Lab.
THE HASL SURFACE AIR SAMPLING PROGRAM Summary Report for 1963
Herbert L. Volchok 15 Jan. 1965 76 p refs
(HASL-156) OTS: $1.75

The data developed in 1963 and a description of the sampling sites, sampling equipment and methodology are presented. During 1963 over 1700 air filter samples and 400 samples of precipitation were assayed for gross gamma concentration, fission and neutron activation products. The results of these analyses indicate that in Northern Hemispheric surface air in 1963, the well documented spring peak occurred and that in general the air was well mixed with respect to fission products. Through most of the year the air of the Southern Hemisphere was not as thoroughly mixed. The trends of various radionuclide concentrations and radionuclide ratios

suggest that a substantial portion of the nuclear debris detected at ground level in the Southern Hemisphere came across the Equator from the troposphere of the Northern Hemisphere. Author

N65-17493# Joint Publications Research Service, Washington, D. C.
ELECTROMAGNETIC PROFILING IN GEOLOGICAL MAPPING
V. G. Ivochkin 26 Feb. 1965 17 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ., Ser. Geol. i Geogr. (Leningrad), v. 4, no. 24, 1964 p 69–77
(JPRS-28926; TT-65-30404) OTS: $1.00

Electromagnetic techniques for determining the subterranean components of a given area are described. Relative advantages of this method over the electric method, which involves a constant current and a low frequency as well a large amounts of wiring, are discussed. A map of a geographic area surveyed by this method is included, and some typical data curves are given. D.E.W.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-16426*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
RECEIVER TECHNIQUES AND DETECTORS FOR USE AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS Semiannual Report, 1 Sep. 1962–28 Feb. 1963
T. E. Tice 1 Mar. 1963 10 p *Its* Rept.-1093-14
(Grant NsG-74-60)
(NASA-CR-50177) OTS: HC $1.00/MF $0.50

A submillimeter radiometer has been designed using a Michelson interferometer as the modulator, a wire mesh as the beam splitter, an Archimedes' cam as the driver of the linear reciprocating motion, and a Golay cell as the detector. Preliminary experiments have been performed on an existing spectrometer using a commercial black-body source. These results showed a minimum detectable temperature of 12° K, which agrees approximately with our analysis. Author

N65-16440*# Hughes Research Labs., Malibu, Calif.
RESEARCH ON GRAVITATIONAL MASS SENSORS Status Report No. 2, 15 Nov.–15 Dec. 1964
Robert L. Forward 15 Dec. 1964 2 p
(Contract NASw-1035)
(NASA-CR-60595) OTS: HC $1.00/MF $0.50

A cruciform sensor head and its associated vacuum chamber was fabricated for test purposes. The sensor head has four arms that vibrate tangentially to the direction of rotation. The initial design frequency was 170 cps (with the speed of rotation to be 5100 rpm or 85 rps). Strain transducers were attached to the stationary sensor and response curves obtained. The Q in air at the resonant frequency (169.5 cps) was 150, but a spurious low Q response was found at 165 cps, which was due to coupling of another sensor mode into the support. The sensor head was cut down to raise the operating frequency to 190 cps to move the desired response away from the spurious response. The reworked sensor had a clean resonance at 190 cps with a Q of 170 in air. The four strain transducers, one on each arm, are matched to within 1 dB and have a voltage–strain characteristic of 3.5×10^5 volts/unit strain. Author

N65-16488*# Stanford Research Inst., Menlo Park, Calif.
HIGH-DEFINITION PHOTOGRAPHY OF PROJECT ECHO I SATELLITE Final Report
R. H. Weitbrecht Jul. 1963 48 p refs
(Contract NASr-49(03); SRI Proj.-3890)
(NASA-CR-53146) OTS: HC $2.00/MF $0.50

Results of high-definition photography of the balloon satellite Echo I are presented. Due to poor seeing as well as to photographic difficulties caused by the specular reflectivity of the object, efforts to delineate the shape of the balloon are inconclusive. A model experiment was undertaken to show what results would be obtained using a satellite coated with various proportions of specular and diffuse reflectivities. Feasibility of photographing a satellite on a flyby, using a fixed telescope system with an image motion-compensating camera, is demonstrated. Author

N65-16516# Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.
LIMITED SURVEY OF COMMERCIAL JET AIRCRAFT ALTIMETER SYSTEM POSITION ERROR BY PACER WITH TRAILING CONE Final Report
Jack J. Shrager Dec. 1964 34 p refs
(RD-64-157)

Limited flight tests were conducted using the trailing cone static pressure measuring technique to determine the repeatability of commercial jet aircraft altimeter systems. The maximum difference between the six types tested at 30000 ft was 500 ft. Author

N65-16524# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INPUT-OUTPUT EXPERIMENT Semiannual Technical Summary Report for Period Ending 30 Sep. 1964
R. E. Meyerott 26 Oct. 1964 21 p refs
(Contract Nonr-3398(00))
(LMSC-8-79-64-1; AD-608154) OTS: HC $2.00/MF $0.50

As part of a study of natural phenomena which can be used to simulate high-altitude weapons effects, a satellite instrument package was prepared and flown in October–November 1963, to get flight experience through regions of precipitating auroral particles with improved low-energy variable threshold electron detectors. The flight showed the consistency with which low-energy electrons and protons are precipitated in the auroral zones on both the day and night sides of the earth. It also yielded much information about the variations in total energy, in energy spectra, and in angular distributions. A significant day–night effect was observed in the northern auroral zone; i.e., the total precipitated energy was considerably larger on the night side, but the electron spectra were harder on the day side. During a May 1963 flight six passes were made over the northern auroral zone. High time resolution measurements showed the large areas and regular nature of low-energy electron precipitation in the auroral zone. Higher energy electrons precipitated in narrower regions. Electron energy spectra derived from these data showed that for this period most of the precipitated electron energy was from electrons, with energies between 1 and 25 keV. R.L.K.

N65-16562# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTICAL RANGE FINDERS WITH INTERNAL BASE LINES
J. Mikulasek 10 Dec. 1964 14 p Transl. into ENGLISH from Jemna Mech. a Opt. (Czech.), no. 9, 1960 p 269–272
(FTD-TT-64-550/1+2; AD-455364)

Optical rangefinders with an internal baseline are divided into two main groups: (1) coincidental rangefinders, and (2) inverted coincidence rangefinders. The coincidental rangefinder is an optical system in the form of a basic triangle, which has the objective lenses at top and determines the distance by measuring the parallaxes. The inverted coincidence rangefinder uses an optical system that inverts one of the separated images, and the images originating in the field of vision are identical with the picture of the object and its reflection. Another method uses a side arrangement of the picture separated by a perpendicular separation line, and determines the distance by moving one target image until the perpendicular dividing line passes exactly through the space between both pictures. The principle of distance measuring is developed for the case of two telescopes of identical optical properties and presented in an analysis. G.G.

N65-16569# Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
AN IRRADIANCE MEASURING SYSTEM USING A TELEVISON SENSOR
R. W. Currie 1 Oct. 1964 20 p refs
(RE-TR-64-25; AD-455398)

A unique method of obtaining radiometric data from a television camera is presented. These data are available in real time over ranges in irradiance far exceeding the linear portion of the sensor's response. The system demonstrates the feasibility of using video pulse area as a criteria for determining irradiance of point targets. A system as described in this report enhances the use of television sensors in measurement programs where radiometric data on multiple targets are desired. Author

N65-16588*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUBNANOSECOND TIME RESOLUTION SINGLE-CHANNEL PULSE-HEIGHT ANALYZER
Theodore E. Fessler and William K. Roberts Washington, NASA, Feb. 1965 12 p refs
(NASA-TN-D-2673) OTS: HC $1.00/MF $0.50

A fast single-channel pulse-height analyzer that employs a unique tunnel diode trigger circuit to generate accurately timed output pulses is described. The analyzer was developed for use in nanosecond nuclear physics coincidence and lifetime studies and will handle approximately 10^4 random pulses per second above the lower discriminator level with negligible output pulse loss. With the radioactive isotope cobalt 60, which produces an essentially simultaneous ($<10^{-12}$ sec) two-gamma-ray cascade, two gamma-ray detectors consisting of plastic scintillator and photomultiplier tube, and two fast single-channel pulse-height analyzers, a resolution curve of 0.57-nanosecond full width at half maximum height was obtained when the upper 25% of the cobalt 60 gamma-ray pulse-height spectrum produced in each of the gamma-ray detectors was used. Author

N65-16619 Minnesota Univ., Minneapolis. Electrical Engineering Dept.
A NEURISTOR REALIZATION
Roy H. Mattson *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 210–213 refs (See N65-16601 07-04)

The application and feasibility of a practical neuristor, that could be fabricated using integrated circuit techniques is discussed. Silicon neuristors were fabricated from a high resistivity P-type substrate. A complete neuristor line device including four injection buttons, two ohmic contacts, and external circuitry with a single bias source was developed and tested. Reflectionless terminations as well as attenuationless propagation were obtained. Bilateral transmission, and destructive collisions of pulses traveling on the same line in opposite directions were observed. G.G.

N65-16620 Wyoming Univ., Laramie. Dept. of Electrical Engineering
A MINIATURE SELF-PULSING OSCILLATOR FOR BIOMEDICAL TELEMETRY
E. Lonsdale *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 215–220 refs (See N65-16601 07-04)

A simple solid-state self-pulsing oscillator for biomedical telemetry was developed. This device can be pulse-frequency modulated by a voltage, a variable resistor, or by ambient temperature changes. Battery life measured in weeks is realized but transmission distances of only a few feet can be used. This oscillator may find use in a narrow field of specialized application where small size, economy, and simplicity outweigh flexibility and long range transmission as determining design factors. Author

N65-16621 Wyoming Univ., Laramie.
APPLICATIONS OF THE SQUEGGING OSCILLATOR IN BIOMEDICAL INSTRUMENTATION
Virgil Ellerbruch *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 222–226 (See N65-16601 07-04)

The development of the low-power transistorized squegging oscillator has given rise to new methods for rf telemetering physiological data over short distances. The information is received on a standard broadcast band receiver, so the data can be recorded manually or processed by standard digital techniques. Three instruments are described: internal temperature transmitter, pulse rate transmitter, and rumen rate transmitter. The small implantable temperature transmitter which transmits reliable data over a period of weeks utilizes the thermal sensitivity of a transistor for modulating a digital signal in proportion to the environmental temperature. A resistive photocell attached to the finger is the sensor for the pulse rate transmitter. The sensed signal is used to gate the squegging oscillator on during systol. The gated tone is received by ear and recorded manually. Certain data are available that were taken during high altitude conditioning studies. The implantable rumen rate transmitter utilizes a resistive element to modulate a digital signal in proportion to the pressure differential. It appears it will be feasible, by circuit refinement, to measure the rumen pressures. Author

N65-16623 Wyoming Univ., Laramie. Dept. of Electrical Engineering
A TELEMETERING SYSTEM FOR REMOTE PRESSURE MEASUREMENT
John W. Steadman *In* AF Acad. Proc. of the 1st Ann. Rocky Mt. Bioeng. Symp. [1964] p 233–238 refs (See N65-16601 07-04)

A telemetering system for remote measurement of pressure between the ball of the foot and the shoe was successfully demonstrated. The system involves a transducer, pulse frequency modulator, transmitter, receiver, pulse shaper, digital to analog converter, and a recorder. The recordings of

pressure under the ball of the foot as a function of time adequately illustrate the results that may be expected from this system. The versatility of the transducer and the rest of the system suggests many other possible uses of this device. The transducer and a similar system are being used to measure the pressure in the stomach of a cow, and it could be used with minor modifications in many other remote pressure measurement applications. Author

N65-16740*# General Mills, Inc., St. Paul, Minn.
EXPERIMENTAL DESIGN STUDY, MICROSCOPIC SYSTEM FOR MARS STUDY PROGRAM, 2 OCTOBER 1962–2 JUNE 1963
D. A. Lundgren, D. D. Mullin, V. W. Greene, L. R. Flink, J. H. Nash et al 14 Jun. 1963 165 p refs Work prepared for JPL *Its* Rept.-2405
(Contracts NAS7-100; JPL-950123)
(NASA-CR-60650) OTS: HC $5.00/MF $1.00

A pneumatic sampler unit prototype to be used with a microscope or some other Martian biological experiment was constructed. The design criteria were established from information obtained by experimentation, and calculations of (1) the best method of aerolizing ground particulate material; (2) the size, size distribution, and concentration of microorganisms in an aerosolized cloud; (3) the best methods of transporting and collecting airborne particles; and (4) the system's power, weight, and volume requirements. Sufficient laboratory data on a sample-processing technique that utilizes liquid separation procedures were obtained to predict the overlay fraction content of a given microbiological material. G.G.

N65-16751# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut für Flugmedizin
MEASURING AND OBSERVATION INSTALLATIONS OF THE CENTRIFUGE AT THE DVL-INSTITUTE FOR AVIATION MEDICINE [MESS- UND BEOBACHTUNGSEINRICHTUNGEN DER ZENTRIFUGE DES INSTITUTS FUR FLUGMEDIZIN DER DVL]
Jan Fremerey Sep. 1964 16 p *In* GERMAN; ENGLISH summary
(DLR-64-05; DVL-367) Available from ZLDI, Munich: 4.80 DM

Measuring and observation installations of a centrifuge are described. Problems that arise when deriving physiological measurement values from a rotational system are discussed. The most important electrical data of the utilized instruments are presented. Author

N65-16771# Joint Publications Research Service, Washington, D.C.
STUDIES ON ASTATIZED QUARTZ GRAVIMETERS AND SYSTEMS
I. L. Vasil'yeva, S. V. Vereda et al 19 Feb. 1965 73 p Transl. into ENGLISH from the book "Ustroystvo, Naladka, Remont, i Ekspluatatsiya Gravimetricheskoy Apparatury" Moscow, Nedra Publishing House, 1964 p 33–84
(JPRS-28836; TT-65-30365) OTS: $3.00

The operation and characteristics of astatized quartz gravimeters are described, and discussions are presented of the instrument's accuracy with respect to random and systematic errors, the adjustment of the optical system, the setting of the levels for minimum sensitivity to inclination, and the testing of the instrument for mechanical stability and freedom from mechanical defects. The calibration and determination of the instrument constants are described in detail. Instructions on the techniques of manufacture and repair of elastic quartz systems for use in the gravimeters are also presented. D.S.G.

N65-16774# Naval Research Lab., Washington, D.C.
THE NRL AIR RESISTANCE METER, MODEL II
K. D. Lawrence, J. A. Young, and R. H. Collins 30 Oct. 1964 10 p refs
(NRL-6173; AD-608718) OTS: $0.50

A new air resistance meter, which provides accuracy, versatility and rapidity of measurement, was designed. It utilizes a system of three parallel air lines, each designed to accommodate a specific range of airflows, and each with its own separate control valve. These serve to furnish a more accurately calibrated span of airflows up to 100 liters/minute. The instrument is mounted on a table making a convenient semiportable laboratory device. This device has a pneumatically operated chuck to hold the filter sample. The chuck provides uniformity and rapidity of operation, and is designed to allow inserts and other alterations to be made easily. This meter can be used in conjunction with other equipment to measure airflow resistance and aerosol penetration simultaneously. Author

N65-16875 Naval Research Lab., Washington, D.C.
THE FABRY-PEROT REFRACTOMETER AND THE PRECISION NRL LYMAN-ALPHA HUMIDIOMETER
F. C. Mac Donald, D. L. Randall, and D. Stillwell *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 173–193 refs (See N65-16862 07-07)

Microcells of atmospheric moisture are believed to be responsible for transhorizon tropospheric radio propagation at vhf and uhf by the scattering mechanism. The object of the fast response instrument development program is to make studies of these microcells in all types of weather conditions so that the meteorologist will have some basis for forecasting radio scattering conditions from a weather map, and for meteorological soundings of temperature, dew point, and refractive index. The humidiometer is a fair weather measuring instrument because it loses sensitivity for water vapor pressure above 8 millibars. E.E.B.

N65-16876 Western Ontario Univ., London.
INSTRUMENTATION FOR LOWER TROPOSPHERIC SOUNDINGS OF REFRACTIVITY
D. R. Hay *In* MITRE Corp. Proc. of the 3d Tropospheric Refraction Effects Meeting, Vol. I Nov. 1964 p 195–205 refs (See N65-16862 07-07)

The region from ground to 3000 feet above ground, the layer of frictional influence, is discussed as one aspect of tropospheric refraction. Motivation for the work stems from research on radar angels, the clear-air reflections observed on sensitive microwave radars. Two instruments are described: (1) A smoke generator in the nose of a rocket deposits an instantaneous vertical column which may be studied for wind shear. (2) A combination instrument measures air refractivity and temperature simultaneously, with rapid response and high degree of spatial resolution. The information from these instruments is used to deduce detailed profiles of temperature and water vapor pressure, and to obtain numbers. E.E.B.

N65-16877# Xerox, Rochester, N.Y.
CONTINUOUS TONE, CHARGE TRANSFER PHOTOGRAPHY
Interim Engineering Report
30 Jan. 1965 29 p refs
(Contract AF 33(615)-1950)
(AD-455520)

Instrumentation was designed, built, and debugged to prepare and evaluate photoreceptor samples in the development of Frost, a photographic system that depends on the image-wise deformation of a plastic to produce a light-scattering image. The process of fabricating five-layer thermoplastic-overcoated selenium–tellurium, selenium plates for use as photoreceptors in described. Sensitivity increased with increasing tellurium content in the alloy and with alloy layer thickness. An unsuccessful attempt was made to correlate thickness and dark discharge. Several specialized devices were built to measure the photographic properties of the prepared photoreceptors, and to allow precise control of the processing parameters—an electrometer sensitometer table, immersion heater, densitometer, and resolution tester. An important experimental problem was the lack of reproducibility of the photographic characteristics. Attempts are being made to correlate the variation with the parameters of charging and development, as well as with the possible variation in the fabrication of the photoreceptors. Low resolution values were obtained, probably due to poor focus adjustment in the lens system of the resolution tester. R.L.K.

N65-16901# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

THE ALPHA ANGLE ADJUSTER

A. S. Kaminski, J. H. Maytag, and D. J. Mc Phee 3 Feb. 1965 14 p

(Contract AT(29-1)-1106)

(REP-480) OTS: $0.50

A device called the Alpha Angle Adjuster was developed. This device enables linear measurements to be made perpendicular to almost any curved surface. Author

N65-16915# Royal Aircraft Establishment, Farnborough (England).

FLUXGATE MAGNETOMETERS FOR MEASURING THE ATTITUDE OF SOUNDING ROCKETS

C. T. Farr London, Min. of Aviation, Aug. 1964 41 p refs

(RAE-TN-SPACE-71)

A brief account is given of the development of a rocketborne fluxgate magnetometer used for attitude measurement in Skylark. The principles of operation are described, and circuit details and comparative performance figures are included for an early and a later version of the instrument. Some limitations of the system are indicated, and information on other types of magnetometers is given. Author

N65-16929*# Raytheon Co., Norwood, Mass.

FAST SCAN INFRARED DETECTION AND MEASURING INSTRUMENT, PHASE I, JUNE 19, 1964–JANUARY 15, 1965

15 Jan. 1965 95 p

(Contract NAS8-11604)

(NASA-CR-60711) OTS: HC $3.00/MF $0.75

In the field of optics an instrument system was designed to the diffraction limit as the limiting dimension, thereby eliminating spurious signals from coma-shaped field plots. In the scan system, a detailed study yielded the information that aberrations from a new and extremely unconventional scan system, the double helix, could be controlled to a smaller magnitude than more conventional systems. In the use of detectors, two developments were significant –the planning of an experiment using an IR optical fiber as a focal plane light pipe to the detector element, and the use of an extremely small detector acceptance angle-aperture combination to enhance sensitivity of the detector. Author

N65-16933*# Electro-Optical Systems, Inc., Pasadena, Calif. Advanced Technology Dept.

IONIZATION CHAMBER-GEIGER TUBE INSTRUMENT FABRICATION PROGRAM Final Report

M. B. Prince 28 Mar. 1964 57 p Prepared for JPL

(Contract JPL-950658)

(NASA-CR-60706; EOS-5030-Final) OTS: HC $3.00/MF $0.50

Three prototype and three flight ionization (ion) chamber–Geiger tube instruments were fabricated, and all units, except the temperature control model, were subjected to vibration and thermal vacuum tests. One prototype was subjected to a more rigorous testing program that included the following: vibration, thermal vacuum, explosive atmosphere, humidity, rf interference, shock, and static acceleration. The flight instruments will be carried on Mariner C spacecraft, and will detect and measure the omnidirectional flux of corpuscular radiation in interplanetary space and near Mars. The energy detection thresholds are 0.5 Mev for electrons, 10 Mev for protons, and 40 Mev for alpha particles. The instrument assembly consists of ion chamber, Geiger-Mueller tube, and electronics subassemblies. The assembly weighs less than 2.6 lb, and its dimensions are 13.4 by 9.8 by 5 in. Power requirements are less than 500 milliwatts. Author

N65-16972# Aberdeen Proving Ground, Md. Ballistic Research Labs.

APPARATUS FOR MEASURING THE STATIC UNBALANCE OF PROJECTILES

Richard D. Kirkendall May 1964 23 p refs

(BRL-MEMO-1564; AD-444332)

An apparatus was developed to measure the static unbalance of projectiles ranging in caliber from 76 to 120 mm. The apparatus consists of an extremely sensitive beam balance with a cross-flexure hinge used for the pivot. The accuracy in determining the static unbalance is generally limited by the concentricity and smoothness of the outer surface of the individual projectile. The measurement errors inherent in the apparatus and procedure are less than one percent (assuming a smooth concentric projectile). Author

N65-16980*# Pittsburgh Univ., Pa. Biophysical Research Lab.

[MICROSPECTROPHOTOMETRIC INSTRUMENTATION FOR THE STUDY OF PIGMENTS AND ORGANIC MOLECULES WITHIN LIVING CELLS] Semiannual Status Report, 1 May–31 Dec. 1963

J. J. Wolken [1963] 5 p

(Grant NsG-230-62)

(NASA-CR-55521) OTS: HC $1.00/MF $0.50

A description is presented of the operation of a microspectrophotometer to be used in obtaining spectra of living cells. P.V.E.

N65-16986*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

RESEARCH ON VIBRATORY-OUTPUT ANGULAR MOTION SENSORS Fifth Status Report, 1 Jun.–30 Nov. 1963

George C. Newton, Jr. 31 Dec. 1963 10 p refs

(Grant NsG-149-61)

(NASA-CR-55537; ESL-SR-189) OTS: HC $1.00/MF $0.50

Research is conducted in the areas of the development of an all-vibratory-type gyroscope in which double modulation is accomplished by vibration rather than by rotation. Results obtained on a double modulated tuning-fork instrument are favorable and indicate the possibility of constructing an inexpensive, low-power, reliable all-vibratory gyroscope with

a zero rate well below one earth's rate. Results are described; problems that have arisen and some of their solutions are indicated; research documentation status is given; and the financial status of research is presented. Specific areas in which experimental data were obtained are: studies of a tuning-fork gyroscope employing rotary double modulation; feedback suppression of cross-coupled signals; and vibratory angular-motion sensors using fluids. C.L.W.

N65-17011# Raytheon Co., Alexandria, Va. Space and Information Systems Div.
ZENITH CAMERA DATA REDUCTION PROGRAM: MERRITT'S MODIFIED DEPENDENCES, A RESEARCH STUDY CONCERNING AN ENHANCED VERSION OF THE METHOD OF MODIFIED DEPENDENCES Final Report
E. L. Merritt, Howard Garcia, and Herbert Chapple Griffiss AFB, N. Y., RADC, Dec. 1964 36 p refs
(Contract AF 30(602)-3338)
(RADC-TDR-64-391, Vol. II; AD-610263)

A primarily analytical study of a developmental data reduction procedure for camera orientation is presented. The method described is an effort to render the known method of modified dependences more rigorous, and to derive the secondary advantages pertaining to the determination of camera constants and the coordinates of an unknown body. A numerical model providing the results of the described procedure and the tangential method are also presented. The numerical model is based upon data obtained from a camera plate. Author

N65-17013# Naval Research Lab., Washington, D.C. Chemistry Div.
MODIFICATION OF THE RINGROSE CARBON DIOXIDE METER Interim Report
S. H. Smith, Jr. 3 Dec. 1964 12 p refs
(NRL-6175; AD-609881)

A carbon dioxide meter was in use in British submarines in 1956. When subjected via field tests to conditions prevailing on U.S. nuclear submarines, it failed to indicate properly after about two days. Upon careful evaluation of the instrument, possible modifications to make the instrument more suitable were proposed. A prototype Mark II featuring the best combination of changes was built and independently evaluated. The English have already equipped their first nuclear submarine, Dreadnought, with four of the instruments. Work has shown that, with further minor alterations, the Mark II should be a very useful CO_2 meter on U.S. nuclear (and other) submarines. Author

N65-17107# California Univ., Davis. Dept. of Nematology
ELECTRONIC COUNTING OF ELONGATED PARTICLES IN SUSPENSION Final Report
D. R. Viglierchio 8 Sep. 1964 5 p
(Grant Nonr(G)-00037-62)
(AD-608696)

Described is a systems design for an instrument capable of counting nematodes individually in the presence of a suspension of debris in the sensing device. This system contains a small tunnel lined with spaced detectors, through which the nematodes will pass as singles and generate a coincidence pulse at the same time. A prototype sensing device was built with a series of detectors to find the proper detector spacings by attaching the counter leads to the appropriate binding posts. The pumping system driving the suspension flow has been constructed. G.G.

N65-17111# Bettis Atomic Power Lab., Pittsburgh, Pa.
AN APPARATUS FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF UNIRRADIATED AND (REMOTELY) OF IRRADIATED SOLIDS IN THE RANGE 100 TO 200°C
D. Jaffe Jan. 1965 34 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-291) OTS: $2.00

A comparative type apparatus was developed for measuring the thermal conductivity of thin (0.050 to 0.150 inch) specimens of solid materials having relatively high thermal conductivities, both prior to and after irradiation. The principle of measurement involves relating the time to boil a given volume of a liquid to the specimen's thermal resistance, where

$$\text{Thermal Resistance} = \frac{\text{Thickness}}{\text{Area} \times \text{Thermal Conductivity}}$$

The apparatus was calibrated for use with 1/2-inch square specimens having thermal resistance values in the range of approximately 1 to 10 sec-°C/cal. In this range of thermal resistances values, the precision of the apparatus was found to be ±0.06 to 0.1 sec-°C/cal. To date, all measurements were carried out at an average specimen temperature of 120°C, but this range can be extended to 100° to 200°C without major modifications to the apparatus. Also, it is felt that the apparatus can readily be calibrated and used for measurements of specimens with thermal resistance values well above 10 sec-°C/cal. Complete procedures for the remote incell measurement of the thermal conductivity of irradiated specimens were developed and are described in detail. Author

N65-17126*# National Research Corp., Cambridge, Mass.
GAUGE CALIBRATION STUDY IN EXTREME HIGH VACUUM
F. Feakes, F. L. Torney, Jr., and F. J. Brock Washington, NASA, Feb. 1965 115 p refs
(Contract NASw-625)
(NASA-CR-167) OTS: HC $4.00/MF $0.75

The very low pressure performance and low pressure limits of certain promising gages were investigated for use at pressures below 10^{-11} torr. The gages chosen were a normal magnetron gage, an inverted magnetron, a nude modulated ion gage, and a suppressor grid gage. An advanced method of calibrating gages in the UHV and XHV ranges was developed and tested with success down to 3×10^{-13} torr. It should be applicable to even lower pressures. Two other response problems were also investigated. The first concerned possible variations in the output signal from an ion gage according to the angle at which a beam of gas entered the grid structure of the gage. Independent of back-scattering, the nude ion gage sensitivity did not appear to be directionally dependent. The second problem was to determine the rate at which an ion gage would respond to rapid changes in gas density. The response time was found to be 2.6 microseconds, a time comparable to that required for an ion to travel from the point of ionization within the grid structure to the collector. In most practical cases, the response time would be determined by the rate of travel of the gas to the gage. R.L.K.

N65-17179# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MEASURING DISTANCE
M. T. Prilepin 23 Nov. 1964 5 p Transl. into ENGLISH of the Russian Patent No. 155949 (Appl. No. 794291/26-10), 11 Sep. 1962 2 p
(FTD-TT-64-487/1+2+4; AD-609789)

The methods of measuring distances with light range finders having an active reflector and a constant phase delay which use photomultipliers do not ensure the possibility of observation during the daytime. The proposed method increases the active range and broadens the possibility of observations during the daytime; the phase delay in the active reflector is eliminated by control of the phase of the modulating voltage, with respect to the light extremum visually observed during the cophasal supply of the modulator and demodulator of the active reflector. Coherence of the oscillation of the modulating voltages of the base station and of the active reflector is ensured with the aid of a reference signal being transmitted onto the active reflector through the radio channel from the generator of the modulating voltage of the base station. Author

N65-17213*# Marshall Labs., Torrance, Calif.
PROTOTYPE SURVEYOR FLUXGATE MAGNETOMETER MODEL ML 125-1 Final Engineering Report
R. Carden, R. Kobayashi, C. Laws, H. Rosenberg, D. Sassa et al 14 Jun. 1962 281 p Prepared for JPL
(Contracts NAS7-100; JPL-950156)
(NASA-CR-60762; ML/TN-2000.70) OTS: HC $6.00/MF $1.50

The primary objective of the program was to design and manufacture a triaxial fluxgate magnetometer to measure lunar magnetic field vectors. Secondary objectives were to perform inflight calibration upon command, to generate inflight bias fields upon command, to perform an inflight analog-to-digital conversion of the magnetic field vector data for transmission over the data link, and to monitor the internal temperature of the unit for data reduction. The magnetometer portion of the unit consists of a set of three fluxgate probes mounted orthogonally in an integrated housing which measure three mutually perpendicular components of the magnetic field vector, and a set of electronic circuits which provide probe drive current, detect the probe outputs, and condition it for transmission over the data link. Inflight calibration is performed upon command for a period of 10 seconds. A calibrating field of 100γ is generated by passing a known current through the probe auxiliary winding. Author

N65-17214*# Space-General Corp., El Monte, Calif.
THEORETICAL AND EXPERIMENTAL PROCESSING OF LUNAR TELEVISION PICTURES Final Report
C. S. Lorens, A. M. Boehmer, and J. Gallagher 29 Nov. 1962 87 p refs Prepared for JPL
(Contract NAS7-100; JPL-950249)
(NASA-CR-60754; SGC-203R-4) OTS HC $3.00/MF $0.75

Possible linear and nonlinear theoretical work, applicable to processing lunar and planetary pictures, is presented, with the theoretical material limited to linear processing. The material deals with exploiting the geometry of pictures principally through the assumption of statistically stationary properties under translation and rotation. Pictures are defined as functions of one index where the index is a two-dimensional vector corresponding to the two-dimensional coordinates of the picture. Representation of the pictures, linear processing, matrix products, correlation functions, stationary and symmetry properties optimum linear processing, trivial processing, orthogonal preprocessing, minimum error, minimization with a constraint, preprocessing with prediction, quantization, and convergence of iterative computations are discussed. The experimental work tests the theoretical results for complexity, usefulness, and correctness. A number of experiments were performed with these pictures to extract in an optimum manner another desired picture. A variety of FORTRAN programs are included for eventually performing the processing computations on a digital computer. Author

N65-17216*# Geophysics Corp. of America, Bedford, Mass.
MASS SPECTROMETER INSTRUMENTATION FOR THE ANALYSIS OF THE MARTIAN ATMOSPHERE Final Report
R. F. K. Herzog and W. P. Poschenrieder 12 Dec. 1962 87 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950328)
(NASA-CR-60760; GCA-62-17-G) OTS: HC $3.00/MF $0.75

Ion sources, ion-orbits in an inversed magnetron gauge, permanent magnet design, and instruments to prove the basic feasibility of a mass spectrometer to analyze the ion beam generated by an inverted magnetron gauge are discussed. The experiments presented show that a simple mass spectra can be obtained with the new instrument. However, resolution is below the requirements for the Martian probe. Nevertheless, the instrument has important good features—uses very little power; is simple; requires one voltage for ion source operation; and needs no filament. E.E.B.

N65-17223# American Science and Engineering, Inc., Cambridge, Mass.
ROCKET-BORNE INSTRUMENTATION TO MEASURE THE RATE OF IONIZATION AND RELATED PHENOMENA DURING AN AURORA, PART I Final Report
W. P. Reidy, G. Davidson, R. Giacconi, O. Shepherd, and R. Smith Jun. 1964 98 p refs
(Contracts AF 19(628)-252; DASA-WEB-07.007)
(ASE-531; AFCRL-64-606(1); AD-610505)

The scientific objectives of the experiments and the individual instruments flown on the Astrobee 200 sounding rocket are discussed in detail. The rocket was instrumented for auroral studies, and included a new detector to measure the rate of ion production during periods of abnormally large ionization. Other detectors, to measure such related phenomenon as particle fluxes and auroral line intensities, were also included. Author

N65-17248# Systems Inc., Orlando, Fla.
FILTER CRYSTAL TEST SET AND STANDARD CRYSTAL MEASUREMENT SYSTEM Final Report, Jul. 1962–Aug. 1964
W. H. Horton and S. B. Boor [1964] 121 p refs
(Contract DA-36-039-SC-90858)
(AD-610469)

The development of two equipments to be used for the measurement of quartz crystal parameters is presented. The characteristics of the filter crystal test set include a frequency range of 0.8 to 100 mc, and the capability for measurements of the main mode, unwanted modes, and static capacitance. The characteristics of the Standard Crystal Measurement System include a frequency range of 0.8 to 200 mc, and the capability for highly accurate bridge-type measurements of all crystal parameters utilizing the servo-bridge technique. The overall crystal measurement problem and the relation of the equipments to this overall problem are discussed. The uses and limitations of the equipment, as well as the relations between the two types of equipment, are also given. Author

N65-17260*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENTATION AND FLIGHT REPORT ON AEROBEE FLIGHTS 4.107 GE AND 4.108 GE
J. W. Cameron Feb. 1965 74 p
(NASA-TM-X-55127; X-671-65-55) OTS: HC $3.00/MF $0.75

Pertinent engineering information concerning the instrumentation and results of Aerobee Flights 4.107 GE and 4.108 GE are given. The scientific objectives of these payloads were to study the very low energy cosmic ray heavy nuclei, using a recoverable payload. This report illustrates the function and performance of instrumentation and telemetry equipment, and does not present an analysis of either scientific data or performance of the vehicle. Author

N65-17262 Aeronautical Research Council (Gt. Brit.)
LOW SPEED WIND TUNNEL CALIBRATION OF A NEW PITOT-STATIC HEAD (Mk.10) INSENSITIVE TO INCIDENCE
D. G. Mabey London, Min. of Aviation, 1964 12 p refs supersedes RAE-TN-AERO-2924, ARC-25707; see X65-15075 (RAE-CP-762; RAE-TN-AERO-2924, ARC-25707) HMSO: 2s

A new pitot-static head (a Mk 10) with a static hole configuration chosen to reduce the static error due to incidence, and a Mk 9H pitot-static head were calibrated in a low speed wind tunnel. On the Mk 10 head the static error due to incidence is virtually eliminated from $-5°$ to $+25°$, and the static error due to sideslip within the range of $\pm 4°$ is not much worse than on the Mk 9H head. Author

N65-17266*# American Science and Engineering, Inc., Cambridge, Mass.
AN X-RAY TELESCOPE
R. Giacconi, N. F. Harmon, R. F. Lacey, and Z. Szilagyi Washington, NASA, Feb. 1965 66 p refs
(Contract NAS5-660)
(NASA-CR-41) OTS: HC $3.00/MF $0.75

An aplanatic total reflection telescope for use in the soft X-ray region was constructed and tested. The telescope has a collecting area of 2 cm^2, an angular resolution of 1 minute of arc, and a field of view of 40 minutes of arc. The focal length is 64 cm. The grazing angle of incidence on the telescope surface is about 1° for paraxial radiation. This results in an efficiency of reflection of 0.2 percent in the 8 to 12 Å region and 5.0 percent at 44 Å. These characteristics make it particularly suited to the study of celestial X-ray sources from rocket- and satellite-borne instrumentation. Author

N65-17269*# Consultants and Designers, Inc., Arlington, Va.
PERSPECTIVES OF PHOTON COUNT APPLICATION IN THE PHOTOELECTRIC TRACKING SYSTEMS UTILIZED IN ASTRONOMY [PERSPEKTIVY PRIMENENIYA SCHETA FOTONOV V FOTOELEKTRICHESKIKH SLEDYASHCHIKH SISTEMAKH ISPOL'ZUYEMYKH V ASTRONOMII]
P. V. Nikolayev, I. P. Rozhinova, and Yu. A. Sabinin 25 Feb. 1965 19 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 32, 1964 p 173–186
(Contract NAS5-3760)
(NASA-TT-F-9647; ST-TS-OA-10297) OTS: HC $1.00/MF $0.50

The possibility is discussed of sensitivity increase in the photoelectric tracking systems' pickups utilized in astronomy by the photon count method. The allowable time interval between two successive data inputs on discordance for local guiding systems is analyzed. The theoretical predictions obtained on the sensitivity increase of photoelectric tracking systems by 2.5 to 3 m for an accumulation time of 4 seconds are confirmed experimentally. Author

N65-17346# Measurement Analysis Corp., Los Angeles, Calif.
DESIGN CONSIDERATIONS AND USE OF ANALOG POWER SPECTRAL DENSITY ANALYZERS
Julius S. Bendat and Allan G. Piersol Denver, Colo., Honeywell [1963] 159 p refs
Available from Honeywell: $2.50

The basic requirements of an analog instrument designed for spectral measurements are investigated in terms of applications to the analysis of both random and periodic data. Signal amplitude detection circuits and dynamic range capabilities are considered in detail, with emphasis placed upon the appropriate design features for vibration data analysis. The statistical uncertainties and resolution errors associated with spectral analysis problems are studied to help establish appropriate filter bandwidth and averaging time requirements for analog measurements. A review is given on the use of an analog spectrum analyzer to evaluate randomness, stationarity, and equivalence of data. Cross-power spectral density analysis is covered, and the features of an appropriate analog instrument are discussed. The application of cross-power spectra measurements to the estimation of linear system frequency response functions is reviewed with emphasis upon the significance of associated coherence functions. Author

N65-17359# Solid State Radiations, Inc., Los Angeles, Calif.
RESEARCH AND DEVELOPMENT ON FABRICATION OF PIN AND LID DETECTORS AND THE DRY RUN INTERFACE SYSTEM Final Report
F. P. Ziemba Washington, AEC, 31 Aug. 1963 88 p refs
Prepared for California Univ., Livermore
(Contract W-7405-ENG-48)
(UCRL-13106) OTS: $3.00

Two types of semiconductor detectors for fast transient high intensity γ-rays were designed, fabricated, and evaluated. The first type is based on the lithium ion drift (LID) technique having a sensitive depth between 1mm and 1cm and active areas between 0.04cm^2 and 1cm^2. The second type is the PIN detector with a sensitive depth of 250 microns and an active area between 0.04cm^2 and 1cm^2. Dry run apparatus was designed for testing the static and dynamic characteristics of these detectors under field conditions. The properties of three different series of field tested detectors are tabulated. One series consisted of LID detectors, one of single PIN diodes, and the third of stacks of three PIN detectors in series. The triple stack of PIN obtained wider dynamic range than that obtained in the single diodes without the loss of speed. R.L.K.

N65-17363# Bissett-Berman Corp., Santa Monica, Calif.
RF RADIATION HAZARD DETECTION AND WARNING DEVICES, PHASES I AND II Final Engineering Report
30 Jun. 1964 104 p
(Contract NObsr-87467)
(AD-604900)

Recognition that physiological damage caused by microwave radiation is a function of the time of exposure as well as the level of power density required to development of an rf-radiation integrator. Phase I of this program resulted in an integrating microwave radiation hazard detector which accumulates incident electromagnetic energy over a 30-sec interval and reads out the total value on a counter. Phase II of this program resulted in a ruggedized, portable, battery-operated rf radiation integrator which accumulates incident electromagnetic energy over a 30-sec interval and actuates visible and audible alarms when total energies exceed given levels. Both instruments utilize E-Cell integration techniques. The E-Cell is a new electrolytic component in which transfer of a platable material between electrodes is proportional to the incident energy. The program included studies and procurement of antennae which were circularly polarized and which approximated hemispherical coverage. Author

N65-17392# Air Force Cambridge Research Labs., Bedford, Mass.
SIMPLE HIGHSPEED KINEMATOGRAPHY OF NANOSECOND EXPOSURE
Heinz Fischer and A. Fritzche (Technische Hochschule Darmstadt) [1964] 10 p refs Prepared jointly with Teschnisce Hochschule Darmstadt
(Contract AF 61(052)-651)
(AD-610594)

Series of nanosecond flashes with adequate light for photographic observation of nonluminous particles of minute size were obtained in transparent and reflecting light by application of dc voltage to the light source. Shotrates up to 10 kc were produced in such a free firing source with a time jitter totaling 0.3 mm sec. This simple method is adequate for the microscopic evaluation of fluid dissipation processes as it is discussed. Studies of the statistics in overall fluid motion require more exact timing if evaluated by motion picture presentation. Author

N65-17407# Pratt and Whitney Aircraft, Middletown, Conn.
DRIFT AND ENDURANCE TESTING OF CHROME/ALUMEL, W-5 Re/W-26 Re AND Mo/W-26 Re THERMOCOUPLES AT 1950F TO 2000F FOR 10,000 HOURS
Salvatore Fanciullo 23 Feb. 1965 40 p
(Contract AT(30-1)-2789)
(PWAC-454) OTS: $2.00

Tests of 1/8-inch OD Cb-1 Zr clad, alumina-insulated Chromel/Alumel, W-5 Re/W-26 Re, and Mo/W-26 Re thermocouples were conducted to determine 10000-hour stability in inert gas at 1950° to 2000° F. The results indicate that all of the above thermocouples drifted less than 1 1/2% for the 10000-hour period. The C/A and W-5 Re/W-26 Re tests remained within a 1 1/2% accuracy limit for the duration of the test. The Mo/W-26 Re thermocouples showed a larger inaccuracy limit due to a poor match of the thermoelements. No test thermocouple failures occurred. Author

N65-17479# Systems Inc., Orlando, Fla.
10 MC. TO 100 MC. INCREASED ACCURACY CRYSTAL TEST SET Final Report, May 1962–Nov. 1964
W. H. Horton and S. B. Boor [1964] 72 p refs
(Contract DA-36-039-SC-90727)
(AD-456482)

The characteristics of the test set, which is of the crystal impedance meter type, include a frequency range of 10 to 100mc, a power range of 10^{-6} to 2×10^{-3} watts, and a resistance range of 5 to 80 ohms. Measurement capabilities include a frequency accuracy of $\pm 1 \times 10^{-6}$, frequency repeatability of $\pm 1 \times 10^{-8}$, and resistance accuracy of ±5% or ±1 ohm. Other features incorporated in the test set include a proportional controlled oven which is adjustable from +70° to +90° C with an accuracy of ±0.1° C and a balanced voltmeter used to determine crystal voltage. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-16503 Joint Publications Research Service, Washington, D.C.
DIFFUSION WELDING OF TITANIUM, TUNGSTEN, AND MOLYBDENUM CARBIDES
A. L. Burykina and O. V. Yevtushenko *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 12–20 refs (See N65-16501 07-17) OTS: $3.00

A study was made of conditions of diffusion welding under vacuum of carbides of titanium, molybdenum, and tungsten with each other and with refractory metals—molybdenum and tungsten. The possibility of diffusion welding of the materials studied at relatively low temperatures and under moderate vacuum conditions (10^{-2} to 10^{-3} mm Hg) was demonstrated. A microstructural study of welds was made and the microhardness values of new phases resulting from reactive diffusion were determined. Hypotheses were formulated as to the mechanism of diffusion welding and the nature of the phases formed therein. Author

N65-16568# Frankford Arsenal, Philadelphia, Pa.
HIGH STRAIN RATE FORMING BY PNEUMATIC-MECHANICAL EQUIPMENT. PHASE I: EXTRUSION OF 1100-0 ALUMINUM
John C. Kiszka and Edward H. Kottcamp, Jr. Dec. 1964 39 p refs
(R-1745; AD-455965)

The work is part of a continuing research program to determine the influence of high-strain-rate deformation on the structural and mechanical properties of selected metals and alloys. The first phase of this effort has been directed toward the development of tooling and instrumentation for performing and recording the process of forward extrusion at high strain rates. A pneumatic–mechanical device was used as the source of energy. The forming experiments were conducted on a simple strain-hardenable aluminum alloy. It is concluded that, in forward extrusion by pneumatic–mechanical equipment, heating due to deformation is nearly adiabatic and can have a significant effect upon the mechanical properties of the formed product. In the strain-hardenable alloy studied, this temperature rise reduced the strength of the extruded rod by annealing. Study of such temperature increases with regard to effects on the properties of extrusions made from heat treatable alloys is recommended. Author

N65-16746*# Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS Semiannual Progress Report, May 14–Nov. 15, 1964
R. C. Emanuelson [1964] 60 p ref
(Contract NAS3-4174)
(NASA-CR-54268; PWA-2518) OTS: HC $2.00/MF $0.50

Coatings of calcium titanate, iron titanate, and a zirconium diboride–molybdenum disilicide composition were subjected to short-term emittance testing. The results indicated that calcium titanate, and iron titanate were suitable for long term emittance testing. Three specimens are being tested in the long-term total hemispherical emittance rigs. The test on AISI-310 stainless steel coated with calcium titanate is being conducted at 1350° F and about 2000 hours have been accumulated. The emittance was stable at 0.91 throughout the period. The second specimen is AISI-310 stainless steel coated with iron–titanate. A total of about 1000 hours with a steady emittance of 0.89 have been accumulated. The third specimen is columbium–1% zirconium coated with iron titanate. The emittance for this specimen varied between 0.88 and 0.85 during 1950 hours of testing at 1700° F. These tests will be continued until each specimen has been tested for 5000 hours. Author

N65-16832*# North American Aviation, Inc., Los Angeles, Calif. Metallic Materials Lab.
DETERMINATION OF THE TIG WELDING CONTROL PARAMETERS AND REQUIREMENTS FOR THE AUTOMATION OF OUT-OF-POSITION WELDING
N. Klimmek 18 Nov. 1963 22 p refs
(Contract NAS8-2601)
(NASA-CR-55821; NA-62-864-2) OTS: HC $1.00/MF $0.50

The oscillating TIG unit was modified for the MIG process. Modifications were made to position the MIG gun on the unit, provide variable dwell and to incorporate an adjustment to change the angle of rotation. Acceptable oscillating weld passes with good side wall fusion were made. Weld bead widths ranging from 1/4 to 1-1/2 inches were obtained with the modified oscillator on 2 and 2-1/2 inch thick aluminum plate. The results indicated that it is feasible to out-of-position weld with the oscillating MIG process. Author

N65-16836*# Army Chemical Corps, Fort Detrick, Md. Physical Defense Div.
USE OF SPORICIDES AND HEAT TO STERILIZE RESINS
Dorothy M. Portner and Raymond R. Jakubauskas 16 Sep. 1963 6 p refs
(NASA Order R-35)
(NASA-CR-52088) OTS: HC $1.00/MF $0.50

The use of sporicides and heat to sterilize resins used to pot electronic assemblies was investigated. Five resins were impregnated with a sporicide, and five resins were subjected to heat curing. Ethylene oxide gas and ethylene imine in absolute methanol were used as sporicides, and the heat treated resins were cured at a temperature of 145° C. Heat curing at 145° C produced resin samples and subcultures that were sterile; ethylene imine was the only promising sporicide for Epon-type resins. C.L.W.

N65-16893*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF ENTRAINED GASES AND A HALOGEN ADDITIVE ON BOUNDARY LUBRICATION OF FOUR OILS AT TEMPERATURES TO 1000°F
Donald H. Buckley, Robert L. Johnson, and William A. Brainard Washington, NASA, Feb. 1965 17 p refs
(NASA-TN-D-2686) OTS: HC $1.00/MF $0.50

Friction and wear studies were conducted to determine boundary-lubrication characteristics of four high-temperature liquid lubricants. The lubricants were a polyphenyl ether, a chlorinated methylphenyl silicone, a paraffinic resin, and a polypropylene. The fluids were examined at ambient temperatures to 1000° F. Measurements were made with the oil as received (containing the normal entrained gases), degassed, and degassed with 10% dibromotetrafluoroethane added as a flammability suppressor and an extreme-pressure agent. Minimum friction and wear were obtained with the nondegassed chlorinated methylphenyl silicone. This fluid, however, produced the greatest amount of solid decomposition products on the specimen surface at 1000° F. Degassing of three of the oils had no conclusive effect on the friction and wear experiments obtained with the oils. The polyphenyl ether, however, appeared to be adversely affected by degassing. Dibromotetrafluoroethane was effective in increasing the spontaneous-ignition temperature of all fluids examined except the polyphenyl ether. Author

N65-16953# American Machine and Foundry Co., Stamford, Conn. General Engineering Div.
LOGISTICAL OVER-THE-SHORE (LOTS) SYSTEMS STUDY, PHASE II
H. Bossung, G. Bott, and R. Gasparrini Sep. 1964 63 p refs
(Contract DA-44-177-AMC-23(T))
(TRECOM-TR-64-DA-44-177-AMC-23; AD-456727)

Recommendations aimed toward the optimization of LOTS system productivity in the 1965–1970 time frame were made. The recommendations considered and the method of analysis to establish their quantitative justification were developed. Author

N65-16974# Republic Aviation Corp., Farmingdale, N. Y. Mfg. Research Dept.
ELECTRO-SPARK EXTRUDING Interim Technical Engineering Report No. 6, 1 Oct. 1964–1 Jan. 1965
J. H. Wagner Jan. 1965 54 p refs
(Contract AF 33(657)-11265)
(RAC-2784; RTD-IR-8-111(VI); AD-454754)

Described are the electrical design aspects relating to capacitors, method of switching, work leads, transmission lines, power supplies, and buss work for sustained firing of a 960 ufd, 18 kV (156 000) joule capacitor bank at intervals of one second between discharges. Sustained repetitive firing tests conducted with ignitrons and a vacuum plasma switch at comparable conditions resulted in the selection of the plasma switch for use in electrohydraulic extrusion. Author

N65-16997# Astron Corp., East Newark, N. J.
PRODUCTION ENGINEERING MEASURE FOR CAPACITOR, VAPORIZED TEFLON, METALLIZED GLOW-DISCHARGED DEPOSITED DIELECTRIC FILM Sixth Quarterly Report, Apr. 1–Jun. 30, 1964
Andrew M. Mc Connell [1964] 39 p
(Contract DA-36-039-AMC-01459(E))
(QR-6; AD-605536)

In the preparation of glow-discharged capacitors, additional capacitors of all three ratings were wound, and tests were performed at each stage of manufacturing to determine, if possible, the particular manufacturing operation which was causing the most difficulty. Although improved yields were reported previously, these yields are still far from acceptable for reliable manufacturing procedures. The major problems encountered were high power factor and low insulation resistance in the 1.0 mfd. and 4.0 mfd. capacitors. One manufacturing procedure, which apparently was causing some difficulty, was the soldering of the pigtails by normal production techniques. It was also found that cooling of the sections to room temperature was necessary to avoid overheating during the spraying operation. Author

N65-17003# Naval Ordnance Lab., White Oak, Md. Explosions Research Dept.
ELECTROPLATING EXPLOSIVE DEVICES
Charles B. Root, James N. Ayres, and E. Eugene Kilmer Feb. 1965 40 p
(NOLTR-64-131; AD-610207)

Techniques for electroplating explosive items are described. Electroplating was used to encase mild detonating fuse terminating detonators, and small pressed charges, both flat-ended and shaped. Conventional lead-sheathed flexible linear shaped charges showed improved performance when plated with a thin sheath of silver. Underwater charges were sealed and confined by electroplating with copper. Fabrication and testing data for the above items plus other suggested applications are given. Author

N65-17022# Defence Research Lab., Kanpur (India).
VOLATILE CORROSION INHIBITORS AND THEIR CURRENT APPLICATIONS

S. K. Gupta and B. Sanyal [1962] 27 p refs

A description is given of the mechanism of protection, advantages of VCI preservation methods, chemicals possessing vapor phase inhibiting property, commercial VCI's, results of practical trials with VCI's, specification for VCI-treated packaging materials, work done in DRL(M) Kanpur, India, how VCI's are used, precautions to be observed while using VCI's, and current application of VCI's. Author

N65-17065*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy

ADHESION BETWEEN ATOMICALLY CLEAN SURFACES. II Final Report, Sep. 1, 1962–Jun. 1, 1963

Douglas V. Keller, Jr. [1963] 41 p refs

(Grant NsG-159-61)

(NASA-CR-50834) OTS: HC $2.00/MF $0.50

A broad definition of adhesion between solid metals is proposed and discussed in order to permit a better understanding of the vast amount of metallic adhesion data being published currently. An interesting result of this definition is that there appears to be real relationship between adhesion phenomena and the processes of friction, cold welding, sintering, grain boundaries strength, and fatigue. A number of experimental techniques are discussed and analyzed so as to increase knowledge of adhesion phenomena. Author

N65-17096# Republic Aviation Corp., Farmingdale, N. Y.

RESEARCH DEVELOPMENT AND TEST OF REFRACTORY METAL ALLOY FASTENERS Technical Documentary Report, 25 Apr. 1961–15 May 1964

C. J. Shaver Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 152 p

(Contract AF 33(616)-8104)

(FDL-TDR-64-113; AD-609653)

The problem of producing and using standard fasteners (metallic) for use to 3000° F was investigated. The investigation included the development of various manufacturing techniques, required for columbium and molybdenum alloy fasteners, and the generation of preliminary strength data on parts fabricated from these alloys. Two molybdenum alloys and three columbium alloys were utilized in the development phase. Two variations in the thread form were also investigated. The final production phase consisted of one molybdenum alloy, TZM, and one columbium alloy, Cb752, with the threaded fasteners incorporating a special thread form. Final approved fastener configurations for both alloys included common rivets, flush head screws, hexagon head bolts, and nuts for use with the threaded fasteners. Blind fasteners were produced from columbium alloys only. Tensile and shear data are presented encompassing the temperature range −320° through 3000° F. Ambient and elevated temperature fatigue and joint test data are also presented. It was found that usable fastener configurations can be manufactured from molybdenum and columbium alloys, and that the resultant items can be successfully coated for satisfactory oxidation protection at nominal utilization temperatures. Extremely large reductions in load carrying capability at ambient temperatures were experienced in the molybdenum alloys after coating. This phenomenon was not as serious in the columbium alloys. Author

N65-17120*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IMPROVED CERAMIC-BONDED CALCIUM FLUORIDE COATINGS FOR LUBRICATING NICKEL-BASE ALLOYS IN AIR AT TEMPERATURES FROM 500° TO 1700° F

Harold E. Sliney Washington, NASA, Feb. 1965 17 p refs

(NASA-TN-D-2688) OTS: HC $1.00/MF $0.50

Modifications in coating procedure and composition that would improve the lubricating characteristics of ceramic-bonded calcium fluoride (CaF_2) coatings were made. The lubricating properties of these coatings were strongly influenced by the details of the coating application procedure. Of particular importance were thorough wet grinding (pebble milling) of CaF_2 and the ceramic binder, the use of a very fine spray when applying the milled material to the substrate, and careful control of firing time and temperature when fusion-bonding the coating to the substrate. A 3% addition of molybdic oxide (MoO_3) to the coating composition and the application of a rubbed film of a fluoride eutectic composition (62% barium fluoride–38% calcium fluoride) were beneficial. Improved performance at 1000° F was also obtained by initially running the specimen at 1500° F to establish a glazed wear track. Common factors in all beneficial modification were a reduction in the porosity of the coating, and an improvement in the homogeneity of CaF_2 dispersion throughout the ceramic binder. Author

N65-17131# Argonne National Lab., Ill. Metallurgy Div.

THE NONDESTRUCTIVE TESTING OF BRAZED JOINTS

Akira Kanno Nov. 1964 30 p refs

(Contract W-31-109-ENG-38)

(ANL-6924) OTS: $2.00

Three nondestructive testing methods, X-ray radiography, neutron radiography, and ultrasonic testing, were compared for detecting faults in brazed joints having a width of 0.0254 mm. Base metals used were ASTM 304 SS mainly. Brazing alloys containing thermal-neutron-sensitive elements were chosen. As standard brazing faults, brazing-alloy foils with thicknesses ranging from 0.0127 to 0.0762 mm, and containing various artificially induced holes were sandwiched between base metals with thicknesses in the range from 1.59 to 6.35 mm. R.L.K.

N65-17135# Bureau of Mines, Spokane, Wash. Mining Research Lab.

FIELD TESTING OF THE EXPLOSIVE-ANCHORED ROCKBOLT

Edward W. Parsons and Lars Osen 1965 45 p refs

(BM-RI-6595)

The explosive-anchored rockbolt was field tested in six mines where rock conditions varied from incompetent shale or mudstone through fairly soft sandstone to firm sandy shales. The purpose was to document, under a wide variety of conditions and in comparison to other rockbolt anchors, the quality of the anchorage produced by the explosive-anchored bolt. In addition, the length, strength, and design of the explosive charge, necessary to produce positive anchorage up to the yield strength of the weakest component of the bolt, were determined. A 14-in.-length beaded explosive charge was found to be suitable, in general, in relatively weak strata, and the length can be reduced in more competent strata. In preliminary tests, properly coupled explosive-anchored bolts did not ignite an explosive gas mixture. Some minor phases included in the investigation were the effects: (1) explosive-anchored rockbolt on surrounding rock, of time on anchored bolts based on torque tests, and of submersion in water on rockbolt anchorage; (2) pull tests to higher loads, and (3) ignition tests. Author

N65-17143# Battelle Memorial Inst., Columbus, Ohio.

DESIGN CRITERIA FOR HIGH-SPEED POWER-TRANSMISSION SHAFTS. PART II: DEVELOPMENT OF DESIGN CRITERIA FOR SUPERCRITICAL SHAFT SYSTEMS Technical Documentary Report, 15 Jan. 1963–30 Sep. 1964

J. E. Voorhees, H. C. Meacham, J. B. Day, and D. E. Close
Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 207 p refs
(Contract AF 33(657)-10330)
(ASD-TDR-62-728, Pt. II; AD-610303)

It was determined that operating power-transmission shafts at supercritical speeds was definitely feasible. By use of the proper damper to damp lateral vibrations, shafts were operated through speed ranges including the 20th critical speed. Additional analytical and experimental work was conducted to determine the relative importance of various parameters to shaft performance at critical speeds. The analytical work included studies of the analogy between a mechanical system composed of a shaft and damper operating at a critical speed, and an electrical system composed of a transmission line and its electrical load. Means were developed for predicting proper damper parameters from this transmission line analogy. A preliminary design of supercritical shaft system for a Vertol "Chinook" helicopter was made. A design manual was written summarizing the design procedure for supercritical shaft systems. Author

N65-17147# Chrysler Corp., Detroit, Mich. Missile Div.
ANALYSIS OF MAINTENANCE TASK TIME DATA (COVERING ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL COMPONENTS DURING WEAPON SYSTEM OPERATIONAL PHASE) Final Report, 27 Oct. 1963–29 Jul. 1964
Griffiss AFB, N. Y., RADC, Dec. 1964 237 p
(Contract AF 30(602)-3229)
(RADC-TDR-64-373, Vol. I; AD-610741)

Maintenance task time data were researched from unscheduled maintenance actions recorded in the field, during the operational phase of the JUPITER Weapon System covering a period of 3 years. Statistical information was computed as minimum-time-to-repair, maximum-time-to-repair, and mean-time-to-repair (MTTR) data for individual components. These statistics were correlated with component identification both by function and Federal Stock Number. Active maintenance times were tabulated on alphabetical nomenclature listings of component-replaceable items grouped by (1) a weapon system summary denoting overall system experience, and (2) an end item summary denoting specific applications within equipments. The active maintenance times were identified in these listings as to minimum, mean, and maximum-time-to-repair levels. These tabulated maintenance task time values and data can be utilized in technical-management appraisals and planning for the engineering of new weapon systems and equipment. Author

N65-17151# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
NONDESTRUCTIVE EVALUATION OF T-III AND B-66 ALLOY TUBING
K. V. Cook and R. W. Mc Clung Feb. 1965 31 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-990)

This report discusses the nondestructive evaluation of approximately 306 ft of T-111 and B-66 alloy tubing with 0.250-, 0.375-, and 0.500-in. Details of the particular nondestructive techniques that were applied are presented, along with the data generated by each testing method. It was shown that the most prevalent discontinuities are located on the outer surface of T-111 tubing and on the inner surface of B-66 tubing. Author

N65-17200*# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF LARGE-INTERNAL-SURFACE-AREA NICKEL METAL PLAQUES Second Quarterly Progress Report, Sep. 18–Dec. 18, 1964
John Mc Callum, G. R. Schaer, D. G. Trevethan, and C. L. Faust
15 Jan. 1965 46 p refs
(Contract NAS3-6003)
(NASA-CR-54299) OTS: HC $2.00/MF $0.50

Electroformed screens of 250, 500, 750, and 1000 mesh have been stacked and bonded into structures 5- to 21-mils thick. The first electrodes prepared have porosities between 38% and 65%. Over 50% is desirable before impregnation. Electrochemical evaluation procedures were completed so that energy outputs from single negative electrodes can be evaluated. Conversion factors and standards for these energy-output evaluations have been determined. Microscopic studies of negatives after repeated deep cycling showed that active cadmium metal powder shifted from large pores into small pores without significant change in weight. E.E.B.

N65-17205# Koppers Co., Inc., Monroeville, Pa.
DEVELOPMENT OF HIGH TEMPERATURE SEAL-LUBRICANT DEPOSIT EVALUATION TECHNIQUES Technical Documentary Report, 1 Feb.–31 Dec. 1963
Billy D. Pfoutz, John S. Lagarias, and Ernest E. Donath Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Sep. 1964 45 p
(Contract AF 33(616)-7893)
(APL-TDR-64-78; AD-610168)

Equipment and procedure refinements were required to develop a more suitable evaluation test for MIL-L-9236-type lubricants as well as for higher temperature fluids. An evaluation test, using an ASD seal-lubricant rig, was under development to determine the performance of lubricants at elevated temperatures. Repeatability and correlation with engine results were established. Procedures are given for cleaning and operating the rig, for evaluating seal deposits, and for detail deposit photography. Seal head design to improve rig operation and facilitate adaptation to the universal tester was constructed. Author

N65-17245# Rock Island Arsenal Lab., Ill.
THERMAL EFFECTS OF ORGANIC MATERIALS ON METALS AND METALLIC FINISHES
W. F. Garland 27 Oct. 1964 23 p refs
(Rept.-64-3159; AD-610559)

Some 27 AIEE Class B (130° C) type organic materials were evaluated for their thermal effects on metals and metal finishes. Gaskets, electric insulation, plastics, sealing compounds, and structural adhesives were investigated in contact with, and in confined close proximity to nine protective metal finishes, i.e., steel, aluminum, anodized aluminum, cadmium plate, chromated cadmium, zinc plate, chromated zinc, magnesium, and copper. Materials were tested at a temperature of 250° F. for 60 days. Rubber–asbestos gasket materials in general were the most corrosive and insulated wires the least corrosive materials tested. Cadmium plate and magnesium were the finishes most susceptible to corrosion by the test materials and anodized aluminum the least affected finish. Normally the most severe corrosion occurred in the contact areas. Author

N65-17276*# Midwest Research Inst., Kansas City, Mo.
DEVELOPMENT OF SOLID FILM LUBRICANTS FOR USE IN SPACE ENVIRONMENTS

Vern Hopkins and Donald Gaddis [1963] 12 p Presented at 1963 USAF Aerospace Fluids and Lubricants Conf., San Antonio, 16-19 Apr. 1963
(Contract NAS8-1540)
(NASA-CR-60783) OTS: HC $1.00/MF $0.50

Friction coefficients are given for many potential lubricants subjected to a light load and temperatures from 80° to 400° F, in both a normal air atmosphere and in a vacuum of 10^{-6} torr. The main criterion for judging the performance of a potential lubricant film was the friction coefficient, which must be less than that obtained for a 0.001-in. thick film of gold. The following lubricant films exhibited lower overall friction coefficients than a 0.001-in. thick gold film: MoS_2 + graphite + bismuth/sodium silicate; MoS_2 + graphite + gold/sodium silicate; MoS_2 + graphite + molybdenum/sodium silicate; MoS_2 + graphite/sodium silicate; and MoS_2 + graphite/sodium phosphate. Author

N65-17299*# National Aeronautics and Space Administration, Washington, D. C.
A CONTRIBUTION TO JET-PUMP DESIGN [CONTRIBUTION A L'ETUDE DES EJECTEURS OU TROMPES HYDRAULIQUES]
Duilio Citrini Feb. 1965 14 p ref Transl. into ENGLISH from La Houille Blanche (France), v. 11, no. 6, 1956 p 837-842 ref
(NASA-TT-F-9263) OTS: HC $1.00/MF $0.50

A study is presented dealing almost exclusively with the operation of jet pumps handling two fluids of equal density and not subject to changes of state. Mixer wall resistance to current motion considered negligible by some, is proved to be far from negligible. Calculations for the efficiency and head loss of a jet pump with a cylindrical mixer are given. The part of the diffuser is also discussed. A vigorous comparison is made between a jet pump with a cylindrical mixing chamber and one with a convergent mixing chamber, calculated in such a manner as to satisfy at once the two Rateau hypotheses that the piezometric height be constant and the wall resistance be zero. Author

N65-17328*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EVALUATION OF FIVE BEARING-SEPARATOR MATERIALS AND POLYPHENYL ETHER LUBRICANTS FOR USE IN SPACE POWER GENERATION SYSTEMS
William R. Loomis Washington NASA, Mar. 1965 18 p refs
(NASA-TN-D-2663) OTS: HC $1.00/MF $0.50

The suitability of five bearing-retainer materials (iron–silicone bronze, S-Inconel, Stellite Star-J, M-2, and M-50) for ultimate use in the mainshaft rolling-element bearings of the SNAP-8 space power generation system was determined in a series of friction and wear experiments. Polyphenyl ether lubricant (type 4P3E) was supplied at 250° F from a drip-feed, once-through system at a rate sufficient to maintain boundary lubricating conditions. The specimen configuration consisted of a hemispherical rider (3/16-in. rad., representing the retainer) sliding at 3600 feet per minute against the flat surface of a rotating disk (2 1/2-in.-diam M-50 high-speed tool steel, representing the raceway and the rolling element) ~300° F. Minimum friction coefficients and the lowest total disk and rider wear were obtained with the iron–silicon bronze specimen, but the other four retainer materials had acceptable friction properties and rider wear volumes in the same order of magnitude as the bronze. Author

N65-17427# Battelle Memorial Inst., Columbus, Ohio.
FLUIDIZED-BED COATING WITH ORGANIC AND INORGANIC MATERIALS
W. M. Goldberger Huntsville, Ala., Army Missile Command, 1 Jul. 1964 63 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-238; AD-456647)

This report reviews the present technology of fluidized-bed coating processes, and deals with the coating of bulk substrates with organic polymers. The use of the fluidized-bed method for obtaining inorganic coatings on metal surfaces is described. The principles of fluidization are discussed in relation to both types of coating. A discussion of performance factors, current applications, cost factors, and the advantages and limitations of fluidized-bed coating processes are included. Author

N65-17429# ARO., Inc., Arnold Air Force Station, Tenn.
OPERATIONAL EVALUATION OF DRY THIN FILM LUBRICATED BEARINGS AND GEARS FOR USE IN AEROSPACE ENVIRONMENTAL CHAMBERS, DECEMBER 7, 1963–JANUARY 27, 1964
T. L. Ridings Arnold Eng. Develop. Center, Feb. 1965 54 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-1; AD-456990)

Test results indicate that dry, thin film lubricants and soft metal plating lubricants can be applied satisfactorily to certain types of bearings and gears, and are capable of sustaining heavy loads at slow speeds in space environments. Author

N65-17472# AiResearch Mfg. Co., Los Angeles, Calif. Aircraft Environmental Systems Dept.
ASD HYDRAULIC PUMP Fourth Quarterly Technical Progress Report, Quarter Ended Nov. 15, 1964
J. L. Sanders 30 Nov. 1964 17 p
(Contract AF 33(657)-10151)
(AAC-4876; AD-456016)

Program activity included resolution of problems encountered during operation of the single-stage pump test rig, and completion of testing of the single-stage pump test rig at speeds to 45 000 rpm. Tests included a run at 42 000 rpm with varying oil viscosities and runs at 45 000 rpm with a cutdown impeller. Results of the single-stage pump tests are presented. The four-stage pump design was reviewed, and changes were incorporated to facilitate testing at 600° F temperatures. Procurement was initiated for all parts required for the four-stage pump. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-16777 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
LIGHT MODULATION DETECTOR Interim Engineering Report No. 2, 15 Jul.–15 Oct. 1964
Russell Targ, D. E. Caddes, E. O. Ammann, W. D. Bush, and G. A. Massey 16 Nov. 1964 60 p refs
(Contract AF 33(615)-1938)
(EDL-M779; AD-608728) OTS: $3.00

Work done on an experimental and theoretical program for the stabilization of a laser local oscillator was divided into three main activities: (1) the assembly and test of the electronic and microwave systems which make up the automatic frequency control loop; (2) the evaluation of the single-sideband suppressed-carrier modulator; and (3) the development

of a technique for laser mode control in which the He-Ne laser is operated in a manner which forces the laser's modes to comprise the sidebands of an FM signal. The development of this FM laser makes possible the use of high-power multimode lasers in many applications previously limited to the use of single-mode lasers with their necessarily lower power. Also reported is work on techniques which allow certain electro-optic devices, such as shutters and modulators, to be used with light of arbitrary polarization. A related technique permitting heterodyne detection of light with arbitrary polarization of the laser transmitter and local oscillator is also described. Author

N65-16791# Precision Instrument Co., Palo Alto, Calif.
COHERENT LIGHT-RECORDING TECHNIQUES Second Quarterly Report, 1 Apr.–31 Jun. 1964
Carl H. Becker Griffiss AFB, N. Y., RADC, Sep. 1964 57 p refs
(Contract AF 30(602)-3272)
(RADC-TDR-64-387; AD-608719)

In a study of techniques for application of coherent light to the problem of high-density, wideband recording and readout, the minimum obtainable bit size on photographic film, as well as the principles of nonmechanical coherent light deflection, was evaluated. Quantum mechanics determine the focusability of the coherent light beam on the basis of the uncertainty principle. Nonmechanical coherent light deflection is conceived electro-optically or magneto-optically, as well as by means of optical diffraction from coherent phonon beams. At the present state-of-the-art, electro-optic deflection with KTN prism cascades appears to be most appropriate. Theoretical recommendations are outlined for the future development of further improved electro-optical deflector materials. Author

N65-16811*# Killsman Instrument Corp., Elmhurst, N. Y.
STUDY OF LASER POINTING PROBLEMS Bimonthly Technical Report, 1 Oct.–30 Nov. 1964
Aaron Wallace 15 Dec. 1964 108 p refs
(Contract NASw-929)
(NASA-CR-60699; KIC-RD-000162-2) OTS: HC $4.00/MF $0.75

The presence of the earth's atmosphere in the communication link with its random turbulence phenomena profoundly affects the system design. It also introduces additional requirements for system synthesis beyond those associated with the extraordinary optical precision due to the narrow beamwidths and the dynamics of closed loop operation with transit time effects and target-observer motions. Attention was concentrated on the "in vacuo" case space vehicle and earth station system configurations, closed loop system analysis, the dynamics of vehicle trajectories and lead angle computations for observer and target motion compensation and the preliminary aspects of laser beam spreading due to atmospheric differential refraction. The report also includes manpower utilization data, and a bibliography of cited references for the main text, mathematical appendixes, and for the appendixes. Author

N65-16819# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
SOME CHARACTERISTICS OF Q-SWITCHED LASERS
P. D. Mc Wane (M.S. Thesis—Ohio State Univ.) 30 Nov. 1964 84 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-18; AD-455880)

Measurements are reported of the variation in power and energy output, beam divergence, and beam intensity from a Kerr cell, Q-switched laser as a function of the parameters of the laser system. Existing theory on power and energy output is reviewed, and an equation for the output is developed which was programed on the computer in an attempt to explain the experimental results. A detailed description of the physical arrangement and the operation of the system is presented. Author

N65-16822# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
DESCRIPTION OF A NOVEL DESIGN IDEA FOR LASER RANGEFINDERS
T. G. Bergman May 1964 10 p refs
(NOTS-TP-3539; AD-443949)

A novel laser-rangefinder design idea that can be used in part or in whole (each part having distinct advantages or characteristics) is presented. Advantages include: (1) only one objective lens for projecting or recollimating laser light and for the collection of the return beam, (2) automatic gain control over return intensity, and (3) no oscillator nor fast time response electronic circuitry. Since spherical aberration and lens configuration are important in this design concept, they are examined in some detail. Author

N65-17148# Sperry Gyroscope Co., Great Neck, N. Y.
COHERENT OPTICAL ARRAY TECHNIQUES Interim Technical Documentary Report, 1 Jun.–31 Aug. 1964
Griffiss AFB, N. Y., RADC, Jan. 1965 60 p refs
(Contract AF 30(602)-3329)
(AB-1272-0016-2; RADC-TDR-64-462; AD-610466)

In an overall plan to demonstrate feasibility by developing a subassembly consisting of a cw laser master oscillator driving two pulsed laser power amplifiers in parallel, an investigation was conducted for an operating wavelength of 1.06 microns. Solid-state and gas lasers were considered for the master oscillator. As no satisfactory 1.06-micron transition was found for a gas laser system, effort is being concentrated on solid-state devices. A Nd:$CaWO_4$ laser has produced a multimode cw output of 160 milliwatts. Single-mode work is being pursued. Solid-state Nd:$CaWO_4$ crystals were grown, cut, polished, and coated for amplifier functions at 1.06 microns. Gain of several dB was measured. Mach–Zender and modified Michelson interferometers were constructed for phase shift and array studies. A KDP electro-optical phase shifter was designed, constructed, and incorporated in the Mach–Zender device. Author

N65-17210# Illinois Univ., Urbana. Gaseous Electronics Lab.
THEORY OF THE LASER INTERFEROMETER AND ITS USE IN PLASMA DIAGNOSTICS
J. B. Gerardo, J. T. Verdeyen, and M. A. Gusinow 1 Dec. 1964 99 p refs *Its* Sci. Rept. No. 1
(GRANT DA-ARO(D)-31-124-G582)
(AROD-4832-2; AD-610321)

The theory of the laser interferometer and its application in investigations of relatively dense to very dense gaseous plasmas are discussed. It is shown that the sensitivity of the interferometer can be greatly improved by utilizing a spherical geometry reference cavity rather than one formed by planar mirrors. The parameters that determine the sensitivity of a spherical geometry laser interferometer are described and detailed theory of such is given. Particular emphasis is placed on determining the maximum frequency response of the interferometer. The parameters that limit the frequency response are given and it is shown that by proper selection of these parameters and proper detection techniques, it is possible to detect resonances at rates in excess of 50 per μsec. Author

N65-17373# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
LASER VELOCIMETRY
Phillip Charles Staas, Jr. (M.S. Thesis) Aug. 1964 62 p refs (GE/EE/64-18; AD-608087)

Laser velocimetry is the measurement of transverse velocity by detection of motion in reflected laser radiation. Reflections from a diffuse surface form a diffraction field which moves in space as the surface moves. A photomultiplier and optical grating detect the diffraction field motion as a frequency spectrum. The center frequency of the detector output is equal to the velocity of the diffraction field divided by two times the width of one grating line. The diffraction field velocity is a linear function of reflecting surface velocity and detector range, and a nonlinear function of incident laser radiation wave fronts. Author

N65-17442# Korad Corp., Santa Monica, Calif.
GaAs LASER DIODES Quarterly Progress Report, 1 Jul.–30 Sep.1964
R. A. Sehr and W. J. Rundle [1964] 27 p refs
(Contract DA-28-043-AMC-00235(E))
(QPR-1; AD-456022)

Device development and laser diode fabrication are described. Experimental work, aimed at improved laser performance, concentrated on diffusion experiments and methods of increasing electrical and thermal contact resistance. Procedures were established for guaranteeing a junction flatness of $\pm$ 0.05μ, and a bonding technique was developed which enables electrical contact resistivities of less than 5×10^{-5} ohm cm^2. A new laser geometry was tested, and a fabrication technique was developed. Twenty laser diodes were mounted on a coaxial copper heat sink. The fabrication and test methods utilized are outlined. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-16383 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE SURFACE TENSION OF TUNGSTEN, MOLYBDENUM, AND RHENIUM
A. I. Pekarev *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 145–148 refs (See N65-16376 07-06)

Surface tension measurements by the drop-separation method on technical grade refractory tungsten, molybdenum, and rhenium gave values of 2220, 1915, and 2610 dynes/cm, respectively. When compared with theoretical values for the surface tension of these metals, only slight deviations were noted for tungsten and molybdenum. However, a large discrepancy (2610 as against 3720) was found for rhenium. E.E.B.

N65-16386 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROLYTIC ETCHING AND POLISHING OF A TUNGSTEN-RHENIUM ALLOY
V. I. Layner, K. N. Usol'tseva, and V. N. Parusnikov *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 164–172 refs (See N65-16376 07-06)

Optimum conditions were selected for the electrolytic surface etching and polishing of VR-20 alloy in alkaline electrolytes. Etching was carried out in an electrolyte containing 15% to 20% NaOH at temperatures of 20° to 80° C and D_a = 0.1 to 10 amp/cm^2. Polishing was conducted in an electrolyte containing 0.5% to 5% NaOH at room temperature and D_a = 0.1 to 10 amp/cm^2. The anodic dissolution of VR-20 in alkaline electrolytes was studied. It was shown that within a certain current-density range the anodic yield with respect to current fluctuates in the vicinity of 100% and is virtually independent of the alkali concentration in the electrolyte, of the current density at the anode, and of the electrolyte temperature. Curves were obtained with coordinates I–V. The working range of the polishing of VR-20 was established as a function of the sodium hydroxide concentration in the electrolyte. It was also established that anodic treatment of the alloy in weakly alkaline and slightly acid electrolytes (at pH of 3 to 10) leads to formation of oxide films which stain the surface of the metal in various colors. Author

N65-16387 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF SOLUTION DECOMPOSITION ON THE RECRYSTALLIZATION OF Al-Cu ALLOYS
M. V. Stepanova and V. Ye. Mogilevskaya *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 173–179 refs (See N65-16376 07-06)

X-ray diffraction was employed to determine the initiation temperature of recrystallization of Al-Cu alloys annealed before cold deformation; it was found to be lower than that for quenched alloys (and for naturally aged alloys); this is explained by the fact that particles of the precipitated phase delay the development of the recrystallization centers. The hot strength of alloys annealed or quenched (or naturally aged) before cold deformation varies in parallel with the recrystallization initiation temperature when the copper content is increased. Author

N65-16388 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF TEMPERATURE AND RATE OF DEFORMATION ON THE MECHANICAL PROPERTIES OF L62 BRASS
N. P. Ageyev *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 180–189 refs (See N65-16376 07-06)

Systematic investigations were conducted on the influence of the temperature-rate deformation factor on the mechanical properties of metals, particularly L62 brass. Increasing deformation rate leads to a significant increase in the deformation resistance of L62 brass. The influence of deformation rate on deformation resistance increases with temperature. Changes in deformation rate have a substantial influence on alloy plasticity. When the deformation rate is raised to $50 \cdot 10^{-1} - 5$ sec^{-1} plasticity rises. The temperature range employed for the hot pressure-working of L62 may be extended by using the optimum deformation rates in the temperature region of brass embrittlement. The increase in plasticity that occurs when the deformation rate is raised is explained by the development during deformation of intracrystalline slip in the grains of the basic phase to succeed the intercrystalline slip along the secondary phase that occurs at low deformation rates and by the decrease in grain size resulting from incompletion of the softening processes of recrystallization. Author

N65-16389 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE APPLICATION OF THE EQUATION OF THE KINETICS OF CRUSHING TO THE MATHEMATICAL DESCRIPTION OF THE PROCESS OF FORMATION OF THE FINISHED PRODUCT IN A BALL MILL

V. V. Diakonenko *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 190–196 refs (See N65-16376 07-06)

A mathematical model for the crushing process and the determination of optimum laws for the process is presented. A new equation of kinetics of crushing is developed based on theoretical concepts and without the empirical relationships which were included in previous equations of Zagustin and Alyavdin. It was concluded that the equation developed will make it possible to get close to the solution of the basic problem—the development of the algorithm for process control based on developed and mastered information systems. E.E.B.

N65-16390 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD FOR THE CALCULATION OF NORMS OF UNCOMPLETED PRODUCTION IN SHOPS PRODUCING REFRACTORY METALS FOR THE ELECTROVACUUM INDUSTRY

A. G. Rutenburg, A. D. Gokhshtand, A. I. Kaz'min, and Yu. I. Proskurovskaya *In its* News of Schools of Higher Educ.: Nonferrous Met. 31 Aug. 1964 p 197–202 refs (See N65-16376 07-06)

Equations are presented for the calculation of uncompleted production in the chemical–thermal sections of refractory metal production facilities. Also, equations are given for those cases where the insurance reserve is equal to a semicycle of production. The total value of uncompleted production in wire sections is also discussed. It is concluded that, by the equations presented, it is possible to determine the norm of the uncompleted production of the largest shops producing heat resistant metals for industry. E.E.B.

N65-16423# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.

ELECTROREFINING OF TITANIUM-OXYGEN ALLOYS

Oliver Q. Leone and F. S. Wartman 1965 24 p refs (BM-RI-6588)

The effect of oxygen content in the anode metal on titanium electrorefining characteristics was studied. Increasing quantities of oxygen in the anode resulted in increased anode scale formation, decreased anode and cathode current efficiencies, lower titanium recovery efficiencies, and higher oxygen content of the cathode products. The titanium electrorefining process performed best when the anodes did not contain more than 0.5% oxygen, although anode dissolution was recorded for alloys containing up to 25% oxygen. Back emf affords a useful index of an alloy to electrorefining. Author

N65-16501# Joint Publications Research Service, Washington, D.C.

INVESTIGATIONS OF STEELS AND ALLOYS

19 Jan. 1965 83 p refs Transl. into ENGLISH from the book "Issledovaniya Staley i Splanov" Moscow, State Comm. on Ferrous and Nonferrous Metallurgy, 1964 (JPRS-28358; TT-65-30154) OTS: $3.00

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1. SURFACE SATURATION OF TRANSITION REFRACTORY METALS WITH CARBON AND BORON G. V. Samsonov and A. P. Epik p 1–11 refs (See N65-16502 07-17)

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3. EFFECT OF RHENIUM AND IRIDIUM ON THE PROPERTIES OF HEAT-RESISTING NICKEL ALLOYS G. V. Yestulin and T. V. Svistunova p 21–26 refs (See N65-16504 07-17)

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5. RELATIONSHIP OF STRENGTH PROPERTIES AT HIGH TEMPERATURES TO HEATING RATE FOR ARMCO IRON AND STEELS 1Kh 18N9T AND EI-925 I. V. Doronin, Ye. K. Zakharov, and I. N. Kidin p 41–46 (See N65-16506 07-17)

6. CAST HEAT-RESISTING ALLOY ALLOYED WITH NITROGEN FOR OPERATION AT 600-700° C Yu. A. Nekhendzi and K. P. Lebedev p 47–58 refs (See N65-16507 07-17)

7. EFFECT OF CASING AND DIE CONE ANGLE ON THE PROCESS OF EXTRUDING HEAT-RESISTING ALLOYS L. M. Moguchiy p 59–68 refs (See N65-16508 07-17)

8. EFFECT OF VARIOUS TYPES OF TREATMENT ON CERTAIN PROPERTIES OF STEELS SN-2 AND SN-3 V. S. Postnikov, G. A. Gorshkov, I. V. Zolotukhin, I. M. Sharshakov, and V. V. Usanov p 69–80 refs (See N65-16509 07-17)

N65-16502 Joint Publications Research Service, Washington, D. C.

SURFACE SATURATION OF TRANSITION REFRACTORY METALS WITH CARBON AND BORON

G. V. Samsonov and A. P. Epik *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 1–11 refs (See N65-16501 07-17) OTS: $3.00

Diffusion saturation with carbon and boron of several d-transition metals was investigated. The phase composition of layers was determined and their structure studied as a function of conditions under which layers were obtained. It is shown that layer growth occurs due to monolateral diffusion of carbon or boron atoms through phases forming on the surface into the metal. Based on metallographic investigations, it was found that with increase in thickness of diffusion layer, its technological properties deteriorate: bonding with the base is weakened, porosity, brittleness, number and size of cracks in the layer all increase. Layers not thicker as a rule than 50 to 75 microns exhibit satisfactory properties. Here, it was noted that for the same metals bonding of boride layers proved better than that of carbide. Constants of reactive diffusion have been determined along with the temperature dependence of diffusion coefficients of boron and carbon in the metals investigated. Author

N65-16504 Joint Publications Research Service, Washington, D.C.

EFFECT OF RHENIUM AND IRIDIUM ON THE PROPERTIES OF HEAT-RESISTING NICKEL ALLOYS

G. V. Yestulin and T. V. Svistunova *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 21–26 refs (See N65-16501 07-17) OTS: $3.00

Results are presented of a study of the effect of rhenium and iridium on the properties of a quaternary alloy of nickel, chromium, titanium, and aluminum, designated KhN77TYu, at room and higher temperatures. These effects are also compared with those of molybdenum and tungsten on the same alloy. The four elements listed are refractory and form alloys with nickel with a range of concentrations. As a result of the study, the four elements can be ranked W, Mo, Re, and Ir, according to the increasing effect on the heat resistance of the alloy. The mechanism by which rhenium and iridium affect properties of the alloy considered is concluded to be similar

to the mechanism of the effects of molybdenum and tungsten, and to consist of strengthening the interatomic bonds in the nickel–chromium based solid solution. D.E.W.

N65-16505 Joint Publications Research Service, Washington, D. C.
ASPECTS OF HOT WORKING OF HARD-TO-FORGE ALLOYS
M. Ya. Dzugudov *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 27–40 refs (See N65-16501 07-17) OTS: $3.00

Steel alloys are divided into five groups, according to their difficulty of forging. The normal method of forging and the drawbacks inherent in it when applied to the especially hard to forge alloys are described, and alternate methods of forging are suggested and discussed in detail. Problems presented by lowered plasticity of hard to forge steels in the deformation temperature region are considered, and several steps are suggested to improve the deformability of these low-plasticity alloys under metallurgical plant conditions. Other subjects covered include the heating of the metal during deformation, characteristics of deforming in a narrow temperature interval, the tendency to form thermal cracks, the tendency to formation of a diversely grained structure in finished articles obtained by hot deformation, and increased formation of inner cracks and gaps in forging and rolling. D.E.W.

N65-16506 Joint Publications Research Service, Washington, D. C.
RELATIONSHIP OF STRENGTH PROPERTIES AT HIGH TEMPERATURES TO HEATING RATE FOR ARMCO IRON AND STEELS IKh18N9T AND EI-925
I. V. Doronin, Ye. K. Zakharov, and I. N. Kidin *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 41–46 (See N65-16501 07-17) OTS: $3.00

Tests were carried out on a vertical breaking machine. A specimen form of a 1.5-mm diameter and a 120-mm long wire was heated under constant tensile load by passing 50 cycle/sec alternating current through it at a known rate until the moment of collapse. The measured voltage and deterioration temperature of the specimen were used as criteria of strength, together with the stresses and temperatures at which elongation reached 0.02% and 0.5%. It was found that, the higher the heating rate, the higher were the temperatures at which self-strengthening was attained, and the further were the specimens elongated during this time. Other effects of rapid heating under stress are discussed for various steels. D.E.W.

N65-16507 Joint Publications Research Service, Washington, D.C.
CAST HEAT-RESISTING ALLOY ALLOYED WITH NITROGEN FOR OPERATION AT 600–700°C
Yu. A. Nekhendzi and K. P. Lebedev *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 47–58 refs (See N65-16501 07-17) OTS: $3.00

New heat-resistant casting alloys for use at 600° to 700° C were sought that would not contain elements that actively form scales. An alloy fulfilling these requirements was found, whose composition is Cr, 16% to 18%; Ni, 13% to 15%; Mo, 1.1% to 1.5%; Mn, 1.0% to 1.5%; Nb, 0.9% to 1.1%; V, 0.85% to 1.1%; Si, 0.3% to 0.6%; N, 0.10% to 0.15%; C, less than 0.1%; and S and P, less than 0.020%. Techniques of preparation and casting of the alloy are described, along with its physical and mechanical properties. D.E.W.

N65-16508 Joint Publications Research Service, Washington, D.C.
EFFECT OF CASING AND DIE CONE ANGLE ON THE PROCESS OF EXTRUDING HEAT-RESISTING ALLOYS
L. M. Moguchiy *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 59–68 refs (See N65-16501 07-17) OTS: $3.00

Results are presented of a study of flow in the extrusion of two nickel-base alloys with different mechanical properties. Component elements of the alloys included chromium, aluminum, titanium, and tungsten. One a commercially available alloy was of adequate plasticity and relatively low heat resistance, and the second alloy had appreciable heat resistance and brittleness. Specimens measuring 46 mm in diameter and 90 mm in length without casings were used in the study, along with specimens in casings with fittings of an iron alloy. Experimental conditions and procedures are detailed, and it is reported that the highly uneven flow of material caused by friction and nonuniform temperature field occurred in the more plastic alloy extruded without a casing. The effect of the entry cone in the die on the metal flow during extrusion was established, and a study of microstructure in various ingot zones was carried out to complete the representation of the state of the extruded material. D.E.W.

N65-16509 Joint Publications Research Service, Washington, D.C.
EFFECT OF VARIOUS TYPES OF TREATMENT ON CERTAIN PROPERTIES OF STEELS SN-2 AND SN-3
V. S. Postnikov, G. A. Gorshkov, I. V. Zolotukhin, I. M. Sharshakov, and V. V. Usanov *In its* Invest. of Steels and Alloys 19 Jan. 1965 p 69–80 refs (See N65-16501 07-17) OTS: $3.00

The influence of various types of treatment on various physicochemical properties of high-strength stainless steels of the transitional austenite–martensite class was studied. The particular parameters examined included internal friction, microhardness, tensile strength, and microstructure. The results are presented in tables and a discussion. D.E.W.

N65-16551*# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.
DIFFUSION COEFFICIENTS IN LIQUID METALS: A COMPILATION OF PUBLISHED LITERATURE
Leo F. Epstein, James D. Mottley, and Judith Q. Pon Oct. 1964 26 p refs
(Contract NASr-108)
(NASA-CR-60608) OTS: HC $2.00/MF $0.50

This report supplements a study on diffusion coefficients in liquid metals, with additional data for aluminum, bismuth, gallium, indium, iron, lead, mercury, silver, sodium, and tin. Included is a bibliography of 44 references. G.G.

N65-16634# Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center
EFFECTS OF SUBSTITUTING COBALT FOR NICKEL ON THE CORROSION RESISTANCE OF TWO TYPES OF STAINLESS STEEL
Milton M. Tilman 1965 21 p refs
(BM-RI-6591)

The effects of substituting cobalt for nickel on the acid corrosion resistance of two types of austenitic stainless steel were determined. Cobalt substitutions to a maximum 2.2 weight percent were made in types 302 and 309 stainless steels. Total immersion corrosion tests were made in 10 volume-percent hydrochloric acid, and boiling-acid tests were conducted in 65 weight-percent nitric acid and in undiluted

glacial acetic acid. For modified type 309 in acetic acid, corrosion rates decreased for additions greater than 0.57 weight-percent cobalt. Corrosion rates increased as cobalt was increased up to about 1 weight percent for modified type 302 in nitric and hydrochloric acids and for modified type 309 in nitric acid, but these rates decreased with a further increase in cobalt content. A gradual increase in corrosion rates with increasing cobalt content was shown for type 302 in acetic acid and for type 309 in hydrochloric acid. Author

N65-16651# Westinghouse Electric Corp., Bloomfield, N. J.
DEVELOPMENT OF INFRARED SOURCES Quarterly Progress Report, 7 Feb.–15 Aug. 1964
N. C. Beese [1964] 11 p
(Contract NObsr-91099)
(AD-608530) OTS: $1.00

The initial work consisted of testing several powdered glass sealing glass compositions that might be used to protect ribbon seals from excessive oxidation. Several seals were cycled between room temperature and elevated temperatures 50 to 100 times with satisfactory performance. A four-element ribbon seal carried 50 A for 250 hrs without deterioration. Author

N65-16666# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Flugzeugban
THE EFFECT OF A SYNTHETIC RESIN COATING ON THE FATIGUE STRENGTH OF A PLATED ALUMINUM ALLOY UNDER PULSATING TENSILE STRESSES [DIE WIRKUNG EINES KUNSTHARZUBERZUGES AUF DIE ERMUDUNG EINER ALUMINIUMLEGIERUNG UNTER ZUGSCHWELLBEANSPRUCHUNG]
W. Wilkens and M. Müller Jul. 1964 35 p refs In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-64-20) Available from ZLDI, Munich: 8 DM

The environmental conditions during the covering of the specimens—gas pressure and composition of gas—are of considerable influence on the number of cycles to failure. This influence is tested for different environmental conditions for an applied cyclic stress of 21.300 psi. The results are compared statistically with regard to a probability of survival of 90%. Author

N65-16667# Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
INVESTIGATION OF THE MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS Quarterly Report, Jun. 1–Nov. 30, 1964
G. C. English and J. Mc Hardy [1964] 45 p refs
(Contract NOw-64-0170-c)
(QR-3; AD-608842)

Extensive measurements were made upon 2-inch thick 7075 alloy plate in two tempers, one susceptible to stress corrosion, and one not susceptible. For these measurements, specimens taken in the short-transverse direction, to provide maximum susceptibility, were tested in an aggressive electrolyte consisting of an aqueous solution of chlorides acidified to pH 1. In this electrolyte, a susceptible specimen stressed to 75% of its yield strength failed by stress corrosion in approximately 1 hour, and a stressed, nonsusceptible specimen failed by general corrosion in 48 hours or less. Two pertinent potentials of cathodic protection were found, the first one 150 mV negative to the corrosion potential, and the second, and much more sharply defined one, 575 mV negative to this potential. Pitting ceased when a specimen was polarized cathodically beyond the first potential, but polarization to the second potential was required to eliminate stress corrosion. Author

N65-16699# IIT Research Inst., Chicago, Ill. Technology Center
STRESS-DEPENDENT INTERACTIONS BETWEEN CESIUM AND OTHER MATERIALS Final Report
David W. Levinson and N. M. Parikh 18 Nov. 1964 74 p refs
(Contract Nonr-3441(00))
(IITRI-B215-22; AD-608671)

A summary of the effects of the presence of cesium liquid or vapor upon the mechanical behavior of materials germane to thermionic diode construction is presented. These studies include static and dynamic bend behavior, tensile behavior at several strain rates, fatigue behavior, and stress stability. The effects studied and reported are reversible in the sense that if the cesium is removed the effect disappears. This type of interaction is known as liquid (or vapor) metal embrittlement. None of the metallic materials was catastrophically embrittled. Reductions in ductility were observed, and, in one case (18-8 stainless steel) a reduction in yield stress was evident. Both tungsten and Kovar showed improved ductility in the presence of cesium. The alumina ceramic materials examined were found to be influenced by cesium unless a glassy grain boundary phase was present. The reduction in strength of the higher (all crystalline) alumina is small. The yttria ceramics examined were seriously weakened by molten cesium. Author

N65-16705# European Atomic Energy Community, Brussels (Belgium).
INFLUENCE OF VARIOUS METALLURGICAL FACTORS ON THE BRITTLENESS OF THE COMPOSITE ALUMINUM-ALUMINA [INFLUENCE DE DIVERS FACTEURS METALLURGIQUES SUR LA FRAGILITE DU MATERIAU COMPOSITE ALUMINIUM-ALUMINE]
M. Desloire 1964 115 p refs In FRENCH; ENGLISH summary
Presented at the Journées Métallurgiques d'Automne, Paris, 14–18 Oct. 1963
(EUR-1846.f) Available from Belg. Am. Bank and Trust Co., N. Y., Account No. 22.186: 165 Belg. Fr.

Due to its physical and mechanical properties, the composite aluminum–alumina can be used in the nuclear reactor as sheathing and structure material. Unfortunately, it possesses a high brittleness at elevated temperature, which is characteristic for such compounds. Realizing the complexity of this material, efforts were made to determine the influence of the various metallurgical factors on the mechanical properties in order to explain its behavior. For this purpose, research was performed on sintered aluminum of different origins, that were subjected to various metallurgical treatments. Author

N65-16731# Joint Publications Research Service, Washington, D.C.
PROPERTIES OF HEAT-RESISTING STEELS FOR HEAT AND POWER ENGINEERING
11 Feb. 1965 80 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 12, Dec. 1964 p 2–31
(JPRS-28725; TT-65-30314) OTS: $3.00

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2. RESTORING THE INITIAL HEAT-RESISTING PROPERTIES OF MATERIALS BY INTERMEDIATE HEAT TREATING I. I. Trunin p 9–18 refs (See N65-16733 07-17)

3. BEND AND WELD-JOINT PROPERTIES OF THICK-WALL 12Cr1MoV STEEL PIPE K. A. Lanskaya p 19–33 refs (See N65-16734 07-17)

4. CREEP TESTING, STRUCTURE STABILITY, AND PROPERTIES OF STEEL M. I. Solonouts p 34–50 refs (See N65-16735 07-17)

5. ONE OF THE REQUIREMENTS OF AUSTENITIC HEAT-RESISTING STEELS FOR POWER MACHINE BUILDING V. N. Gulyayev p 51–59 refs (See N65-16736 07-17)

6. BENDING STRESS AND CRACK FORMATION IN WELD JOINTS OF AUSTENITIC STEEL STEAM LINES V. A. Nakhalov and V. D. Kolyayev p 60–68 refs (See N65-16737 07-17)

7. LONG-TIME STRENGTH OF WELDED EI-756 STEEL STEAM SUPER-HEATER AND STEAM LINES A. A. Zakharov and T. A. Kolodkina p 69–77 (See N65-16738 07-17)

N65-16732 Joint Publications Research Service, Washington, D. C.

HEAT-RESISTING STEELS FOR HEAT AND POWER ENGINEERING

I. R. Kryanin, I. L. Mirkin, and L. P. Trusov *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 1–8 (See N65-16731 07-17) OTS: $3.00

A brief review is given of grades of steel that are, or might be, recommended as construction materials for components and assemblies for steam power electric stations. The primary requirements to be made of these steels, the basic type of alloy (a low-alloy pearlitic heat-resistant steel), the alloying elements to be included, the advantages of martensitic–ferritic steels, and the temperature ranges of different types of steel are discussed. Compositions of the appropriate pearlitic, high chromium, or austenitic steels are tabulated for the various parts for a turbine plant. Alloys and their compositions are discussed for possible use as forged rotors and discs, cast turbine housings and frames, superheaters and steam piping, and blades and brackets. D.E.W.

N65-16733 Joint Publications Research Service, Washington, D. C.

RESTORING THE INITIAL HEAT-RESISTING PROPERTIES OF MATERIALS BY INTERMEDIATE HEAT TREATING

I. I. Trunin *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 9–18 refs (See N65-16731 07-17) OTS: $3.00

The possibility of healing damages accumulated in an alloy at various stages of fracturing under creep conditions was investigated. An intermediate heat treatment was tried on three steel alloys. Test conditions are given, the variation of density during creep testing is shown, mechanical properties before and after the intermediate heat treatment are tabulated, and the variation of the density of a given forging alloy after stress rupture is displayed. Tests indicated that the intermediate heat treatment permits the elimination of most of the failure centers up to creep half-life. It is suggested that the service life of heat-resistant components of an electric power station can be increased by intermediate heat treatments performed after 25 to 30 percent of the design service life. D.E.W.

N65-16734 Joint Publications Research Service, Washington, D. C.

BEND AND WELD-JOINT PROPERTIES OF THICK-WALL 12Cr1MoV STEEL PIPE

K. A. Lanskaya *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 19–33 refs (See N65-16731 07-17) OTS: $3.00

Data are presented on the bend and weld-joint properties of thick-walled (60 to 70 mm) pipes made from a Cr-Mo-V steel. Heat-treated thick-walled pipes were cut into sections. Some of the sections were cooled quickly with water and oil, and some were cooled slowly in quiet air, all from 980° C. Both groups of pipe sections were then annealed at 750° C for 5 hours. Cooling curves are given, chemical composition and mechanical properties are tabulated, and thermokinetic curves are given for the formation of various phases in the alloy. Some pipes were bent, heated, cooled quickly, and annealed. They were sectioned and tested for stress-rupture strength, and examined for microstructure. Some pipes were heated, cooled quickly, and annealed, and then were joined by preheating, welding, and annealing. Finally, the joints were tested for microhardness, composition, and stress-rupture strength. Optimum methods of bending and welding are described. D.E.W.

N65-16735 Joint Publications Research Service, Washington, D. C.

CREEP TESTING, STRUCTURE STABILITY, AND PROPERTIES OF STEEL

M. I. Solonouts *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 34–50 refs (See N65-16731 07-17) OTS: $3.00

Two steel alloys were tested for creep, structural stability, and other properties over a very long heat soak. The alloy designated LA-1 contained about 14% Cr, 15% Ni, 1% W, 2% Mo, 3% Co, 0.3% Ti, 0.6% Mn, and traces of C, Si, S, and P. The alloy named EI-257 contained about 13% Cr, 14% Ni, 2.5% W, 0.6% Mo, 0.6% Si, 0.5% Mn, and traces of C, S, P, and Ti. Samples were taken from the same heats that were used in fabricating a turbine and some steam piping. Tests were conducted at a stress of 14 kg/mm^2 and at a temperature of 580° C for periods approaching 100 000 hours. In addition to the creep and stress-rupture tests, so-called "witness samples" were given isothermal soaking at 585° to 590° C for varying lengths of time and then were examined and tested, in order to describe the kinetics of the aging process. The microstructures of samples were determined at various positions relative to cracks and failures, and changes in microstructure and in strength of the samples and of parts removed from operating machinery are noted. D.E.W.

N65-16736 Joint Publications Research Service, Washington, D. C.

ONE OF THE REQUIREMENTS OF AUSTENITIC HEAT-RESISTING STEELS FOR POWER MACHINE BUILDING

V. N. Gulyayev *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 51–59 refs (See N65-16731 07-17) OTS: $3.00

Corroded sites in a high-pressure steam system were examined, and samples of similar austenitic steel were treated and tested. It is concluded that, for use in a steam medium, it is advisable to use austenitic steels without stabilizing additions of niobium and titanium. Steels with these elements are necessary if the working medium is steam condensate. Steels that are susceptible to intercrystalline corrosion are especially susceptible to the presence of oxygen and chlorine ions in the water. D.E.W.

N65-16737 Joint Publications Research Service, Washington, D. C.

BENDING STRESS AND CRACK FORMATION IN WELD JOINTS OF AUSTENITIC STEEL STEAM LINES

V. A. Nakhalov and V. D. Kolyayev *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 60–68 refs (See N65-16731 07-17) OTS: $3.00

An analysis of the defects of welded joints in austenitic steel steam lines did not establish the decisive importance of

the bending stresses in the formation of cracks. Cracks were also formed when bending stresses were significantly lower than those permitted by specifications. The reduction, below specified levels, of thermal stresses by increasing the flexibility of the steam lines did not eliminate the causes of crack formation. D.E.W.

N65-16738 Joint Publications Research Service, Washington, D. C.
LONG-TIME STRENGTH OF WELDED EI-756 STEEL STEAM SUPER-HEATER AND STEAM LINES
A. A. Zakharov and T. A. Kolodkina *In its* Properties of Heat-Resisting Steels for Heat and Power Eng. 11 Feb. 1965 p 69–77 (See N65-16731 07-17) OTS: $3.00

Experimental data are presented on the stress-rupture strength of welded joints of steam superheater tubes and steam lines made of a steel alloy. The steel alloy contained about 11% Cr, 1.9% W, 0.7% Mn, 0.7% Mo, 0.2% V, 0.2% Ni, 0.3% Si, and traces of C, Cu, P, and S. The stress-rupture strength of the resistance-welded joints in steam superheater tubes of the EI-756 steel is significantly lower than that of the parent metal of the tube both under internal pressure loading and in bending. The reduced stress-rupture strength of the welded joints is caused by the low creep resistance of the sections of the tube close to the welded joint that are weakened in the process of welding. The stress-rupture strength in bending of the electric-arc-welded joint of the EI-756 steel steam tube is 85% of the stress-rupture strength of the parent metal in tension. Failure of the welded joints occurs along the fusion zone with low deformation of the basic tube and of the deposited metal. The reduction of the stress-rupture strength of the welded joint is due to the low stress-rupture strength of the fusion zone. D.E.W.

N65-16747*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Equipment Labs.
GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Sixth Quarterly Report, Sep. 26–Dec. 26, 1964
J. C. Sawyer, C. H. Philleo, and R. Ebert 15 Jan. 1965 49 p
(Contract NAS3-2545)
(NASA-CR-54287) OTS: HC $2.00/MF $0.50

Creep data are presented for tungsten, tungsten–25% rhenium, TZM molybdenum alloy, and AS-30 columbium alloy with photomicrographs of the microstructure before and after test. On the basis of the current test results, the creep strength of tungsten is less than that of tungsten–25% rhenium sheet alloy at 3200° F. In the case of turbine alloys at 2000° F, preliminary tests show that the TZM alloy in the forged condition has a greater creep strength than cross-rolled AS-30 plate material. Author

N65-16749*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MECHANICAL PROPERTIES, OXIDATION CHARACTERISTICS, AND WELDABILITY OF TWO UNCOATED AND COATED VANADIUM-BASE ALLOYS
Dick M. Royster, Charles R. Manning, Jr., and Cynthia A. Dysleski Washington, NASA, Feb. 1965 56 p refs
(NASA-TN-D-2616) OTS: HC $3.00/MF $0.50

An experimental investigation was made to evaluate two vanadium-base sheet alloys for aerospace applications in the 1800° to 2400° F (1260° K to 1590° K) temperature range. The investigation consisted of mechanical property tests at both room and elevated temperatures, and of oxidation tests on coated and uncoated material. Three silicide diffusion coatings were evaluated by continuous and cyclic oxidation testing to determine their protective qualities. An X-ray study, a metallographic examination, and hardness measurements were made to identify and locate the elements and compounds present in the coating and substrate before and after elevated-temperature exposure. Fabrication and joining of the alloys are discussed. A description of the equipment and procedures utilized in performing the evaluation tests is included. Author

N65-16756# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RANDOM SCATTER CHANNELS
E. J. Kelly, Jr. 4 Nov. 1964 51 p *Its* Group Rept.-1964-61
(Contract AF 19(628)-500; ARPA Order 512)
(ESD-TDR-64-571; AD-451756)

In many radar and communications problems, communication is established between transmitter and receiver by means of electromagnetic scattering from a region of space illuminated by the two antenna beams. Scatter channels in which the perturbation of free-space propagation conditions responsible for the scattering is complicated, and amenable to a statistical treatment, were studied. This rules out simple line-of-sight communications problems and radar problems involving a small number of targets. It includes, however, communications via tropospheric scatter or orbiting dipole (West Ford) scatter, and the theory of radar return from a turbulent, ionized gas, or from a collection of many metallic scatterers. Author

N65-16757# Bureau of Mines, Albany, Oreg. Metallurgy Research Center
THE HAFNIUM-VANADIUM SYSTEM
D. K. Deardorff, M. I. Copeland, L. L. Oden, and H. Kato 1965 15 p refs
(BM-RI-6594)

The hafnium–vanadium phase diagram was constructed within an estimated accuracy of ±10° C and ±2 wt% composition. Alloys for investigation were melted under an atmosphere of purified helium by nonconsumable tungsten-electrode arc melting on a water-cooled copper hearth. Melting points were determined by optical pyrometer, and the remaining phase relationships were investigated by metallography, thermal analysis, and X-ray diffraction. The existence of a face-centered cubic intermetallic compound HfV_2 (a_0 = 7.38 A) was confirmed. A eutectic reaction occurred at 20 wt% vanadium and 1395° C to yield HfV_2 and β solid solution. The HfV_2 melted incongruently by a peritectic reaction at 1480° C, and the β solid solution decomposed eutectoidally at 1165° C and 6 wt% vanadium to yield HfV_2 and α solid solution. The eutectoid, the eutectic, and the peritectic isotherms extended from 1 to 36.3 wt% vanadium, from 8 to 36.3 wt% vanadium, and from 26 to 89.5 wt% vanadium, respectively. Terminal solid solubilities of hafnium in vanadium at 1300° C, and of vanadium in hafnium at 1100° C were determined to be about 3 and 1 wt%, respectively. Author

N65-16779# Honeywell, Inc., Hopkins, Minn. Honeywell Research Center
THE MECHANICAL AND MICROMECHANICAL PROPERTIES OF BORON Interim Report, 1 Sep.–31 Oct. 1964
J. A. Sartell and C. J. Speerschneider 19 Nov. 1964 14 p refs
(Contract NOw-64-0159-f)
(IR-V; AD-451915)

Measurements of the micromechanical behavior of zone melted boron were made using a compression testing technique. Casting procedures and sample preparation were modified to improve cast boron for future microstrain testing. Author

N65-16825# Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research
FUNDAMENTAL STUDIES OF CONTACT FATIGUE Progress Report No. 3, Oct. 24, 1964–Jan. 24, 1965
R. A. Burton and J. A. Russell 24 Jan. 1965 53 p ref
(Contract NOw-64-0460-d)
(RS-441; AD-455439)

Experiments are described for lubricated and unlubricated 52100 tool steel contacts under high frequency oscillatory normal load at Hertz stresses from 375000 to 720000 psi. The effect of several different lubricants on fatigue life and on contact wear is demonstrated. Statistical analysis of fatigue life data shows significant differences between lubricant types. Author

N65-16843*# Texas A&M Univ., College Station.
A MATHEMATICAL INVESTIGATION OF THE STRUCTURE OF LIGHT METALS
E. R. Keown, G. E. Abdo, and C. W. Conatser [1963] 4 p refs
(Grant NsG-239-62)
(NASA-CR-51664) OTS: HC $1.00/MF $0.50

The development of a computer program to obtain numerical solutions for the electron-nucleus interactions of neutral lithium by means of the unrestricted Hartree–Fock method is reported. This program is a modification of a previously written program for Hartree–Fock solutions without exchange for normal beryllium. The emphasis on lithium is being shifted, however, because the usual interpretation of the results obtained for lithium by means of the unrestricted Hartree–Fock equations is not entirely acceptable, and because it appears that the atomic beryllium investigations can be most usefully extended to the study of solid-state or metallic beryllium. M.P.G.

N65-16886*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY OF FOUR TITANIUM-ALLOY AND FOUR STAINLESS-STEEL SHEET MATERIALS AFTER EXPOSURES UP TO 22 000 HOURS AT 550°F (561°K)
George J. Heimerl, Robert M. Baucom, Charles R. Manning, Jr., and David N. Braski Washington, NASA, Feb. 1965 74 p refs
(NASA-TN-D-2607) OTS: HC $3.00/MF $0.75

Results are presented of an investigation of the stability of four titanium-alloy and four stainless-steel sheet materials after prolonged exposure without stress at 550° F (561° K); these materials are representative of the types considered for the skin of a supersonic transport. The effect of exposures up to 22 000 hours was determined from changes in the tensile and notch properties at room temperature (80° F (300° K)) and at −110° F (194° K) and from changes in strain-rate sensitivity and tensile spot-weld strength at room temperature. Metallurgical studies were made to determine microstructural changes in the materials due to the exposure. With the exception of one titanium alloy and one stainless steel, the materials were apparently stable for the exposure times completed so far. A marked deterioration in the tensile spot-weld strength, however, was obtained for the titanium alloys and some of the stainless steels due to the exposure. Author

N65-16897# Northrop Corp., Hawthorne, Calif. Norair Div.
DEVELOPMENT OF IMPROVED METHODS, PROCESSES, AND TECHNIQUES FOR PRODUCING STEEL EXTRUSIONS Final Report, Apr. 1958–Mar. 1964
L. M. Christensen Wright-Patterson AFB, Ohio, AF Mater. Lab., Jul. 1964 339 p
(Contract AF 33(600)-38713)
(NOR-64-68; ML-TDR-64-231; AD-608891)

A repetitively producible extruding process was established for 0.060-inch constant-thickness T-sections in high strength steel alloys. With good metallurgical control, warm drawing techniques will further reduce the section to 0.040-inch thickness at ±0.003-inch tolerance and an excellent surface finish. However, a differential in extruded sectional thickness in this range complicates metal flow and lubrication considerably. A total of 324 billets were used by the four different subcontractors involved in both experimental and pilot production efforts. The primary facets controlling success were, in probable order of importance, billet temperature, container temperature, die life, and lubrication. In the further refinement of the shapes by warm drawing, excessive point breakage was experienced on the draw bench because of the substantial reduction in load-carrying capability of the point. To solve this problem, it became necessary to transform the metallurgical structure of the point to martensite in contrast to the austenitic condition of the drawn length. This was effectively accomplished by subcooling in dry ice. Warm drawing was very beneficial in reducing work hardening and draw load. Author

N65-16904# Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.
EQUILIBRIUM STRUCTURES IN THE HIGH URANIUM-ALUMINUM ALLOY SYSTEM Topical Report
J. A. Straatmann and N. F. Neumann 11 Nov. 1964 23 p refs
(Contract W-14-108-ENG-8)
(MCW-1488) OTS: $2.00

The boundaries and phase fields existing in uranium alloys containing from 80 to 4000 ppm by weight aluminum at temperatures from 600° to 1200° C were determined from differential thermal, metallographic, and microprobe analyses. The phase diagram and the methods used to determine it are included, as well as micrographs of the studied specimens. Photographs of retained beta-uranium and the resulting shear-transformed alpha-uranium are also included. Author

N65-16949# Joint Publications Research Service, Washington, D. C.
METALLURGY OF RARE METALS AND ACCESSORY MINERALS
Ya. P. Sheyn and N. V. Gudima 29 Jan. 1965 43 p refs
Transl. into ENGLISH from the book "Kratkiy Spravochnik Metallurga po Tsvetnym Metallam" Moscow, 1964 p 348–386
(JPRS-28534; TT-65-30229) OTS: $2.00

The rare metals are classified in five groups: light rare metals, rare metals of high melting temperature, trace rare metals, rare-earth metals, and radioactive rare metals. Brief accounts are given of methods of recovery for tungsten, molybdenum, selenium, tellurium, and titanium. Information is presented on the occurrence, recovery, and uses of gallium, indium, thallium, germanium, and rhenium. R.L.K.

N65-16957# Union Carbide Research Inst., Tarrytown, N. Y.
THE ELASTIC PROPERTIES OF POLYCRYSTALLINE TUNGSTEN, 24° C–1800° C
R. Lowrie and A. Gonas Jan. 1965 16 p refs
(Contract DA-30-069-ORD-2787)
(C-27; AD-455888)

The velocities of ultrasonic shear and compressional waves in polycrystalline tungsten (99.4% dense) were measured by a pulse-echo technique at temperatures from 24° to 1800° C. Adiabatic elastic constants were calculated from these velocities with accuracies of ±0.25% to ±0.65%, and corrections were applied to obtain the equations for the elastic constants, G, L, K, E, and ν, of fully dense tungsten vs. temperature (° C). Author

N65-16965# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MANUFACTURE OF FINE-CERAMIC PRODUCTS FROM BERYLLIUM OXIDE

Karl Pump and Kurt Entress 23 Jan. 1965 7 p refs Transl. into ENGLISH from Silikat Technik (East Germany), v. 11, no. 10, 1960 p 463–464

(FTD-TT-64-1078/1+2; AD-455873)

Dressing, shaping, drying, and calcinating beryllium–oxide briquets are reviewed. The importance of great purity of raw material is emphasized. The physical properties of beryllium–oxide bats, with emphasis on gas inclusion and its effect on the mechanical strength characteristics, are discussed. It is pointed out that beryllium oxide has the best thermal properties of ceramic high-temperature materials. In contrast to other oxides, bending, compression, and tensile strengths are poor. E.E.B.

N65-16985*# Pressure Technology Corp. of America, Woodbridge, N. J.

AN INVESTIGATION OF FLUID EXTRUSION OF METALS First Quarterly Report, 2 Jul. 1963–30 Sep. 1963

Alfred Bobrowsky 30 Sep. 1963 37 p refs

(Contract NASw-742)

(NASA-CR-52038) OTS: HC $2.00/MF $0.50

Tensile tests under pressure have begun on NASA Nickel-Base Alloy TAZ-8. Fluid-to-fluid extrusions have been conducted successfully on series 300 Mar-Aging steels, both annealed and hardened. Several lubricants have been evaluated in the fluid-to-fluid extrusion of steel. Excellent finishes can be produced. Author

N65-17008# Naval Research Lab., Washington, D. C. Metallurgy Div.

PROPOSED PHASE DIAGRAM FOR THE SYSTEM MAGNESIUM OXIDE—VANADIUM PENTOXIDE

A. J. Pollard 14 Feb. 1964 11 p refs

(NRL-6038)

The liquidus–solidus regions of the system MgO-V_2O_5 were investigated over the entire composition range, with the following principal findings: There are two congruently melting compounds; $2MgO \cdot V_2O_5$ melting at 1128° C, and $3MgO \cdot V_2O_5$ melting at 1210° C. A third compound, $MgO \cdot V_2O_5$, is thought to have an incongruent melting point at 762° C. There are three eutectics: one at approximately 15 mole-percent V_2O_5 melting at 1192° C, one at approximately 30 mole-percent V_2O_5 melting at 1122° C, and one at approximately 75 mole-percent V_2O_5 melting at 658° C. Author

N65-17024 Joint Publications Research Service, Washington, D. C.

ROLLING SAP STRIP DIRECTLY FROM POWDER

V. P. Severdenko, Ye. B. Lozhechnikov, and V. A. Shelamov 17 Feb. 1965 7 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), No. 11, 1964 p 88–90

(JPRS-28790; TT-65-30347) OTS: $1.00

A technological process is recommended for rolling sintered aluminum powder (SAP) foil directly from powder. This is more economical than rolling pressed briquets, the method used in rolling sheet material. The procedure consists of cold compacting or hot rolling to a thickness of about 2.5 mm per run, annealing at 620° C for 3 hours, and hot rolling with heating to 450° C for five minutes before each run. Area reduction per run is 10%. Strips several meters long and up to 100 mm wide were obtained with this process. R.L.K.

N65-17030# Brown Univ., Providence, R. I. Div. of Engineering

ON THE INTERACTION OF EDGE DISLOCATIONS Technical Report No. 13

Tai-te Wu Jan. 1965 15 p refs

(Contract AT(30-1)-2394)

(NYO-2394-13)

The well-known equation governing interaction between two edge dislocations of opposite signs on the same slip plane is rederived with the use of the complex variable technique. A correlation can then be made between the shear stress required to move one isolated edge dislocation and the maximum collapsing distance of the above pair through the interaction of their elastic fields. For copper, this gives an error of two orders of magnitudes as compared with experimental results. Possible explanations are suggested. Author

N65-17033# Los Alamos Scientific Lab., N. Mex.

TENSILE TESTS ON INVAR SHEET AT CRYOGENIC TEMPERATURES

David T. Eash 3 Feb. 1965 14 p refs

(Contract W-7405-ENG-36)

(LA-3192-MS) OTS: $1.00

A series of tensile tests was conducted on 0.005-in.-thick Invar sheet in the mill-annealed condition at 300°, 77°, and 20° K. The tests were made to determine the yield and tensile strengths, notched-to-unnotched strength ratio, ductility, and toughness at cryogenic temperatures. It was observed that the yield and tensile strengths increased at low temperatures by a factor of at least two; the ductility remained good; and the toughness, as indicated by the notched-to-unnotched tensile strength ratio, decreased. Author

N65-17038# Brown Univ., Providence, R. I. Div. of Engineering

A STUDY OF THE MECHANICAL PROPERTIES OF HIGH-COBALT CEMENTED TUNGSTEN CARBIDES Technical Report No. 12

K. N. Tu and J. Gurland Jan. 1965 20 p refs

(Contract AT(30-1)-2394)

(NYO-2394-12; TR-12)

The mechanical properties of cemented tungsten carbide–cobalt alloys were investigated in the composition range of 50 to 70 volume percent of cobalt. It was found that the fracture strength and hardness increase with decreasing particle size of WC, and that the data are not in disagreement with the concept that particle diameter is the governing variable over most of the range. Author

N65-17049# Yale Univ., New Haven, Conn. Hammond Lab.

X-RAY DIFFRACTION STUDY OF IMPERFECTIONS IN RHENIUM

C. N. J. Wagner and E. N. Aqua Jul. 1964 29 p refs

(Contract Nonr 609(43))

(TR-10; AD-608737) OTS: $2.00

An analysis was made of the broadening of the powder pattern peaks from rhenium powders exhibiting different strength properties in the green compacts, and from deformed rhenium sintered sheet. The primary source of the line broadening was the small particle size of the crystallites; broadening attributed to lattice distortions was small or negligible. Evidence was found for growth faults on the (002) planes in the samples studied, and most significantly in the powder of the low green strength briquet (one fault every 100 (002) planes) and in the deformed sheet rhenium. Author

N65-17095# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF FRACTURE MECHANISMS, THERMAL STABILITY, AND HOT-STRENGTH PROPERTIES OF CONTROLLED POLYPHASE ALLOYS Quarterly Progress Report No. 3, Sep. 13–Dec. 12, 1964
M. J. Salkind, B. J. Bayles, F. D. George, and J. A. Ford 12 Jan. 1965 30 p refs
(Contract NOw-64-0433-d)
(D-910239-3; AD-455343)

The results of continued investigations concerning the effect of phase particle size on tensile strength, thermal stability, and hot-tensile strength of unidirectionally solidified Al-$CuAl_2$ and Al-Al_3Ni eutectic alloys are reported. Additional ingots for tensile testing were produced, using a semiautomatic temperature controller in conjunction with a water-cooled crucible end plug. Thermal stability studies of Al-$CuAl_2$ samples indicate somewhat increased breakdown in samples solidified at 5.0 cm/hr over those solidified at 2.2 cm/hr, although the lamellar structure is essentially maintained. Analysis of hypo- and hyper-eutectic microstructures of Al-Al_3Ni alloys indicates that aluminum acts as the nucleating phase. Preliminary room temperature tensile data failed to show any significant relationship between solidification rate and tensile strength in either the Al-$CuAl_2$ or the Al-Al_3Ni system within the range of solidification rates studied. Fractographic analysis indicates that failure in both systems is initiated by cleavage of the harder phase, followed by plastic flow of the ductile phase. Author

N65-17187# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TENDENCY OF STEEL TOWARD CORROSION CRACKING IN VARIOUS MEDIA
F. F. Azhogin and Yu. K. Pavlov 9 Dec. 1964 10 p refs Transl. into ENGLISH from Korroziya i Zashchita Metallov, Sbornik Statey, Oborongiz (Moscow), 1962 p 112–117
(FTD-TT-64-643/1+2; AD-610344)

The dependence of time, up to the appearance of cracks, upon the magnitude of applied tensile stresses within limits of elastic deformations for many instances of corrosion cracking of soft and high strength steels, magnesium, aluminum, and copper alloys in various media has a hyperbolic nature and is sufficiently accurately expressed by the equation of the corrosion cracking curve.

$$(\delta - \delta_{CR})\tau = \kappa$$

Critical stresses δ_{CR} and the constant K appear to be quantitative characteristics of the alloy's tendency toward corrosion cracking. Investigations were carried out on various samples of steel. Results show that the tendency of steel toward corrosion cracking during the pickling in acid depends largely upon its composition. E.E.B.

N65-17188# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
Cr-Ti PHASE DIAGRAM
V. N. Svechnikov, Yu. A. Kocherzhinskiy, and V. I. Latysheva 9 Jan. 1965 8 p refs Transl. into ENGLISH from Sb. Nauchn. Tr. Inst. Metallofiz., Akad. Nauk, Ukr. SSR (Kiev), no. 16, 1962 p 132–135
(FTD-TT-64-680/1+2; AD-610325)

A complete phase diagram for the system Cr-Ti is reported. The alloys were prepared from electrolytic chromium annealed in hydrogen. Titanium iodide was prepared with a nonconsumable tungsten electrode and copper water-cooled crucible in a medium of purified argon. Fifteen alloys were investigated. Tungsten admixture did not exceed 0.004% by weight and copper did not go over 0.066%. The fusibility diagram has a temperature minimum at 1400° C and 55% by weight of Ti. The fusion curve of the solid beta-solution has a maximum at 1365° C and 40% of Ti by weight. The solubility of titanium in chromium at 1000° C, determined by X-ray analysis, amount to 8% of Ti by weight. E.E.B.

N65-17199*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Fourth Quarterly Progress Report, 20 Aug.–19 Nov. 1964
R. W. Buckman, Jr. [1964] 36 p refs
(Contract NAS3-2542)
(NASA-CR-54288; WANL-PR(Q)-005) OTS: HC $2.00/MF $0.50

Development of dispersion strengthened tantalum base alloys for use in advanced space power systems continued with the tentative selection of three compositions that will be melted as 4-inch diameter ingots. Continuing investigations of response to heat treatment has shown that Ta-W-Zr-N and Ta-W-Mo-Re-Zr-N alloys are age hardenable systems that show promise for use as turbine materials. A procedure for the addition of nitrogen to first melt electrodes was established. Author

N65-17202# IIT Research Inst., Chicago, Ill. Technology Center
VANADIUM ALLOY STUDIES Bimonthly Report, Oct. 1–Nov. 30, 1964
F. C. Holtz 11 Dec. 1964 15 p ref
(Contract NOw-64-0239-c)
(IITRI-B6021-5; AD-609727)

The development of vanadium alloys having improved short-time creep properties at temperatures up to 2400° F is described. The alloy V-40Cb-30Ta-1Ti and this base complexed with various combinations of boron, carbon, hafnium, and silicon were readily cold rolled after thermal homogenization of the arc-melted ingots; in some cases a 2400° F press forging operation was required for initial ingot breakdown. Most of the compositions exhibited twinning when deformed at room temperature, and unusually high room-temperature strength and ductility were obtained—the alloy containing 0.23 wt% Si and 0.075 wt% C had a density-corrected ultimate strength of 650 000 psi/(lb/in^3), with 24% elongation. Addition of 1.5 wt% Hf and 0.075 wt% C produced a substantial increase in the 2200° F creep resistance of the V-40Cb-30Ta-1Ti base. Author

N65-17203# Pressure Technology Corp. of America, Woodbridge, N. J.
RESEARCH ON HYDROSTATIC EXTRUSION OF THE TZM ALLOY AT AMBIENT TEMPERATURE Technical Documentary Report, 1 May–1 Nov. 1963
A. Bobrowsky and E. A. Stack Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 103 p refs
(Contract AF 33(657)-11236)
(ML-TDR-64-205; AD-607682)

Tensile tests and compressive tests under pressures up to 450 000 psi on TZM molybdenum alloy, at room temperature, provided data on yield point, ultimate tensile strength, and ductility as a function of environmental fluid pressure. These data in turn indicate the initial feasibility of metalworking under pressure at room temperature without cracking or fracture. The specific metalworking process chosen was fluid-to-fluid extrusion. Using the fluid-to-fluid extrusion of TZM molybdenum alloy, it was determined that any of several fluids

was suitable as the extrusion medium. Excellent finishes could be obtained even from rough-surface billets. Reductions in area up to 4:1 were made without fracture, although it is believed that much larger reduction are feasible. The experimental work was conducted on TZM molybdenum alloy in the forms of stress-relieved, recrystallized, and as-cast material. It was found that stress-relieved material actually was in a state of high residual stress. Techniques were developed for eliminating the difficulties caused by these stresses. Typical improvements in physical properties were increases in ultimate tensile strength, and in yield strength by 50% by fluid-to-fluid extrusion with a 2:1 reduction. The corresponding percent elongation decreased 33% and the percent reduction in area decreased 15%. Author

N65-17209# Air Force Systems Command, Wright-Patterson, AFB, Ohio. AF Materials Lab.
RELATIONSHIP OF COMPOSITION TO LATTICE SPACINGS OF SINGLE PHASE ALLOYS Technical Documentary Report, Aug. 1961–Aug. 1962
Craig S. Hartley Sep. 1964 12 p refs
(ML-TDR-64-242; AD-607721)

The relationship of average interatomic distances to composition in single-phase alloys is discussed in terms of the relationship

$$r_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} P_{ij} r_{ij},$$

where r_0 is the average interatomic spacing, P_{ij} is the probability of an ij pair, and r_{ij} is the spacing of an ij pair for alloys of n components. Sample calculations on existing data show that, within the precision of most composition and lattice parameter data, the P_{ij} can be considered to be those of a random arrangement of atoms, and the r_{ij} can be considered constant over a single phase field. Although this oversimplified picture is at variance with the physical situation as inferred from diffuse X-ray scattering measurements of short-range order and from thermodynamic data, it is felt that an equation of the form presented represents a more generally useful and precise relationship between lattice parameters and compositions of alloys than the generally used linear form of Vegard's Law. Author

N65-17219*# Hanford Atomic Products Operation, Richland, Wash.
A STUDY OF TUNGSTEN-TECHNETIUM ALLOYS Quarterly Progress Report, 1 Jul.–1 Oct. 1964
1 Oct. 1964 14 p refs Work Performed for NASA
(Contract AT(45-1)-1350)
(NASA-CR-60736; HW-84309) OTS: HC $1.00/MF $0.50

Two compacts of 100% Tc powder were arc melted. Total loss in the two nominal 40-gram buttons after five melting cycles was 0.634 grams or 3/4 %. Radiation from each button was 4800 mrad including 8 mrad gamma at 1 1/2 in. Analytical data obtained on the as-reduced powder, and arc-melted material are given. The macrostructure of the as-cast arc-melted metal is fine grained, and not columnar in nature like tungsten. Small inclusions, presumed to be TcO_2 or Al and Si oxides, were observed in the polished condition. A microhardness traverse indicated hardness variation from DPH 113 to 189. Lower values were generally in strain free areas. Hammer forging of a button encapsulated in a heavy-walled stainless steel compact produced no edgecracking at a height reduction of 42%. The technetium surface after removal of the sheath was extremely rough, with depressions apparently related to the cast grain size. Data concerning the binary phase diagrams of tungsten with rhenium and technetium are shown. The major difference is that only one intermediate phase was identified in the W-Tc system where two exist in the W-Re alloy system. R.L.K.

N65-17235# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
DEVELOPMENT OF IMPROVED STRENGTH AND OXIDATION RESISTANCE IN CHROMIUM COMPOSITES Quarterly Report, Sep. 17–Dec. 16, 1964
Wayne A. Farrington and Robert V. Watkins 15 Jan. 1965 22 p refs
(Contract NOw-64-0321-c)
(QR-3; AD-456895)

Work accomplished included refinement of oxidation test procedures, establishment of a basis for comparison of oxidation resistance, evaluation of one material containing a supplemental ceramic dispersion, and fabrication of a number of billets containing supplemental oxides and alloys for strengthening. The addition of silica to the basic chromium–magnesium oxide composite material caused a slight increase in oxidation resistance and protective scale stability. Author

N65-17250# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
BERYLLIUM—REVIEW OF RECENT DEVELOPMENTS
Hugh D. Hanes 26 Feb. 1965 3 p refs

Abstracts are given of a number of papers presented at the AIME Second International Conference on Beryllium Technology held in October 1964. They concern crystallography, purification of beryllium, powder metallurgy, forging, forming and deformation characteristics, and application of beryllium in structural use and in precision instruments. R.L.K.

N65-17296# Western Gear Corp., Lynwood, Calif. Systems Management Div.
HIGH ENERGY RATE FORGING DEVELOPMENT, PHASE IV First Interim Technical Progress Report, Jan.–Jun. 1964
F. L. Parkinson Jul. 1964 54 p Forging subcontracted to Precision Forge Co.
(Contract AF 33(600)-42523)
(WGC-647-226; AMC-TR-7-866(VII); AD-608314)

High energy rate dynapak forging of a thin webbed gear blank configuration was studied using Vascojet 1000 and 4340 steel alloys. With this given configuration, laps or cracks at the web-rim intersection are markedly affected by final web thicknesses and percent upset per blow. Sound parts were produced with web thicknesses of about 0.180 inches. Description of the forging processes along with all forging parameters are given, and the results are examined in terms of dimensional reproducibility hardness surveys, tensile properties, and metallographic analysis. Author

N65-17313# Los Alamos Scientific Lab., N. Mex.
HIGH-DEFORMATION-RATE EXTRUSION OF THIN-WALLED TUNGSTEN HEMISPHERES
James M. Dickinson 28 Jan. 1965 18 p
(Contract W-7405-ENG-36)
(LA-3181-MS) OTS: $1.00

A method of producing a thin-walled tungsten hemisphere from a solid cylinder of tungsten in a single operation using a high-deformation-rate extrusion process was investigated, and the preliminary results indicated that the method was feasible. A tungsten–carbide die coating was developed that successfully protected the die set from serious damage during the extrusion process. Author

N65-17331*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RELATION OF LATTICE PARAMETERS TO FRICTION CHARACTERISTICS OF BERYLLIUM, HAFNIUM, ZIRCONIUM, AND OTHER HEXAGONAL METALS IN VACUUM
Donald H. Buckley and Robert L. Johnson Washington, NASA, Mar. 1965 15 p refs
(NASA-TN-D-2670) OTS: HC $1.00/MF $0.50

The friction characteristics for three hexagonal metals (zirconium, hafnium, and beryllium) were determined in vacuum. The relation of these metals with crystal parameters and shear stress is discussed. Friction experiments were conducted with a hemispherical rider sliding on the flat surface of a rotating disk. The rider was loaded to 1000 grams, and experiments were conducted to surface speeds of 2000 feet per minute. Experiments were conducted with the metals sliding on themselves and on 440-C stainless steel. Zirconium and hafnium showed a decrease in friction with increase in sliding velocity, while beryllium exhibited an increase in friction coefficient with increase in sliding velocity. This relation can be related to resolved shear stresses and in turn to crystal lattice parameters. The decrease in friction characteristics with sliding velocity of zirconium can be related to lattice parameters. A general relation was found between 14 hexagonal metals and their crystal lattice parameters. Author

N65-17338# Horizons Incorporated, Cleveland, Ohio.
REINFORCEMENT OF NICKEL CHROMIUM ALLOYS WITH SAPPHIRE WHISKERS Interim Report, 29 Apr.–28 Jul. 1964
Richard W. Sicka and Mark S. Vukasovich 1 Sep. 1964 36 p refs
(Contract NOw-64-0125-c)
(IR-3; AD-605839)

Studies were continued toward elucidating means whereby high-volume-percent alpha alumina whiskers loadings can be incorporated into refractory metal matrices to yield high-strength composite structures. These studies used titanium and zirconium hydrides as sources of oxide reactive agents and vacuum metallizing of whiskers to promote their liquid metal infiltration. Vacuum metallizing of whiskers with chromium appears promising toward securing nichrome–alumina whisker composites where the whiskers are present in high-volume content. Author

N65-17344# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESS-RUPTURE STRENGTH OF STEEL IN LIQUID SODIUM CONTAINING OXYGEN
V. I. Nikitin 6 Dec. 1963 12 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 14, no. 4, 1962 p 613–617
(FTD-MT-63-146; AD-606278)

The results are presented of testing chromium–nickel austenitic steel for stress–rupture strength at 700° in air and in sodium, containing 0.01 and 0.25 wt% O_2. The lowering of time prior to the rupture and increase in rate of steel creep in sodium with 0.25% O_2, in comparison with an air medium, is fixed. The observed effects are explained by the corrosive and absorptive effect of the medium. Author

N65-17444# Hydronautics, Inc., Laurel, Md.
HIGH FREQUENCY FATIGUE OF METALS AND THEIR CAVITATION DAMAGE RESISTANCE
A. Thiruvengadam Dec. 1964 43 p refs
(Contract Nonr-3755(00) FBM)
(TR-233-6; AD-456365)

High-frequency fatigue tests were conducted for five metals to determine the significance of plastic strain energy in cavitation damage resistance. The tests confirmed the results of previous experiments—that plastic strain energy is the most significant factor in cavitation damage resistance of metals. The tests also revealed the influence of corrosion on cavitation damage resistance. These tests showed that the fatigue strength of SAE 1020 steel is reduced significantly in 3% NACL solution. This confirms an earlier postulation—that increased cavitation damage in a corrosive environment results from deterioration of the strength due to corrosion fatigue. C.L.W.

N65-17455*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Equipment Labs.
DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM Second Quarterly Report, 1 Oct. 1964–1 Jan. 1965
C. R. Honeycutt and J. C. Sawyer 12 Feb. 1965 23 p refs
(Contract NAS3-6010)
(NASA-CR-54286) OTS: HC $1.00/MF $.0.50

The final design of the vacuum fatigue test chambers was reviewed and approved for manufacture. Work is continuing with a bench setup to study the problems associated with the development of a suitable loading system. The current design, which employs a piezoelectric transducer, a 200-watt amplifier, and stepped horns operating at resonance (approximately 20 kcs), is capable of consistently producing fatigue failure in 1/4-inch-diameter brass specimens at room temperature. Author

N65-17457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GRAIN GROWTH IN DILUTE TUNGSTEN-BORON ALLOYS
Peter L. Raffo and Robert F. Hehemann (Case Inst. of Tech.) Washington, NASA, Mar. 1965 25 p refs
(NASA-TN-D-2649) OTS: HC $1.00/MF $0.50

The grain-growth behavior of arc-melted tungsten and several binary tungsten–boron alloys (0.005 to 0.67 at.% B) was studied in the temperature range 3600° to 4200° F. The alloys were prepared by arc melting sintered electrodes of tungsten and elemental boron powders, followed by extrusion and swaging. Specimens cut from the swaged rod were recrystallized at 3200° F to insure that only grain growth would take place in the subsequent annealing treatments. The grain-growth kinetics were followed by measuring the decrease in grain-boundary surface area β as a function of time at temperature. At 3600° and 3800° F, the decrease in β obeyed a power law of the form $\beta = kt^{-n}$, where t is time and n and k are constants. At 4000° and 4200° F, however, the power law was no longer obeyed because of the onset of discontinuous grain growth. In the latter case, discrete grains in the structure, termed secondaries, consumed the primary grain matrix resulting in the formation of a duplex structure. The incubation period for the onset of discontinuous grain growth increased with increasing boron content. Author

N65-17459*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF CRYSTAL STRUCTURE ON THE FRICTION AND WEAR OF TITANIUM AND TITANIUM ALLOYS IN VACUUM
Donald H. Buckley, Thomas J. Kuczkowski, and Robert L. Johnson Washington, NASA, Mar. 1965 16 p refs
(NASA-TN-D-2671) OTS: HC $1.00/MF $0.50

The friction and wear characteristics were determined in vacuum (to 10^{-9} mm Hg) for titanium and titanium alloys sliding on themselves and on 440-C stainless steel. The titanium alloys included titanium–tin, titanium–oxygen, and titanium–zirconium. The influence of tin and oxygen on the lattice parameters of titanium and its friction and wear characteristics were measured. The effect of crystal transformation from a hexagonal to a cubic form for a zirconium–titanium alloy was also studied. Friction and wear experiments were conducted with a hemispherical rider sliding on a flat disk surface at loads to 1000 g and speeds to 2250 ft/min. Experiments were conducted at 75° and 425° F. While most hexagonal metals have good friction and wear properties, the results indicate that titanium, although a hexagonal metal, exhibits relatively high friction. This high friction may be related to a difference in the slip mechanisms for titanium; titanium unlike most hexagonal metals slips on the $\{10\bar{1}0\}$ planes rather than on the (0001) basal plane. The addition of tin or oxygen to titanium expands the crystal lattice of titanium and reduces the friction and wear characteristics. The friction coefficient obtained for a titanium–zirconium alloy markedly increased; complete seizure occurred when the material transformed from the hexagonal to the cubic form. Author

N65-17482# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF PHASE-REINFORCED HIGH-TEMPERATURE ALLOYS PRODUCED DIRECTLY FROM A MELT
M. J. Salkind, F. D. Lemkey, B. J. Bayles, and J. A. Ford 15 Jan. 1965 30 p refs
(Contract DA-19-020-AMC-00434(X))
(D910261-2; AMRA-CR-64-05/1; AD-453442)

The results of continued investigations on potential whisker-reinforcing high-temperature eutectic alloys are presented. Ingots of Ni_3B-Ni were unidirectionally solidified at rates from 2.2 to 10.9 cm/hr to form band-free ingots with lamellar microstructures. Ingots of Ni-NiBe cast from higher purity nickel and beryllium and unidirectionally solidified at rates above 2.2 cm/hr without end quenching resulted in colony formation. Zone melting of the Ti-TiB system in a cold crucible showed it to be of the anomolous eutectic type. The crystallographic relation between the Ni-NiBe phases in a famellar eutectic grain was determined and described. The results of tensile tests and fractographic analysis on specimens machined from unidirectionally solidified and as-cast ingots of Ni-NiBe alloys indicate that, although there is satisfactory load transfer between the two phases, the NiBe phase cannot sustain a large amount of elastic strain, and true whisker reinforcing is not achieved. Author

N65-17487# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
FRACTURE CHARACTERISTICS OF STRUCTURAL METALS Third Quarterly Progress Report, Jul. 23–Oct. 22, 1964
M. F. Amateau and E. A. Steigerwald 20 Nov. 1964 31 p refs
(Contract NOw-64-0186-c)
(ER-5937-2; AD-608591) OTS: $2.00

The variation of yield strength with plane strain fracture toughness (K_{IC}) and the tempering temperature effect on K_{IC} for AISI 4340 Steel, both measured at room temperature, is reported. The K_{IC} is defined as the stress intensity parameter in the vicinity of a crack tip just prior to plane strain crack extension and theoretically is a material constant independent of specimen geometry. E.E.B.

N65-17494# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
HIGH-STRENGTH STEELS—REVIEW OF RECENT DEVELOPMENTS
T. P. Groeneveld 12 Feb. 1965 4 p refs

The important observations and conclusions of studies in the following areas are reported: welding techniques and fracture-toughness tests of welds on 18Ni–7Co–5Mo maraging steel plate; applicability of 18Ni maraging steel for large rocket booster cases through evaluation of mechanical properties of the parent material, evaluation of welding properties, and construction and hydrobursting of a pressure vessel; embrittlement and corrosion resistant characteristics of titanium–cadmium plate on steel; effect of microstructure and strength level on hydrogen-induced delayed failure; and tensile and impact properties of investment-cast low-alloy steels. D.S.G.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-16424# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
PHILOSOPHY FOR THE DESIGN OF PRIMARY AIRCRAFT STRUCTURES WITH FIBROUS REINFORCED COMPOSITES (FRC)
Ralph L. Mc Guire, Jr. Nov. 1964 24 p refs
(AFFDL-FDTS-64-TM-41; AD-608439)

Emphasized is a possible approach to establishing usable design philosophies for utilizing fiber reinforced composites for major airframe components. It outlines the general nature of these materials with accompanying thoughts for assessing the material characteristics. Advantages and disadvantages of these materials are listed, with more emphasis on areas of needed research. An attempt is made to associate these research areas with the appropriate technical field of interest. Author

N65-16556# Kaysam Corp. of America, Patterson, N. J.
NEOPRENE ELASTOMERS FOR BALLOON FABRICATION Third Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Eric Nelson [1964] 48 p
(Contract DA-36-039-AMC-03737(E))
(Rept.-3; AD-456021)

Work was conducted on the following tasks: Task A—Properties of polymers, compounds and balloons—The evaluation of Neoprene Latex LD-569 and compounds and procedures were derived, which permitted satisfactory inflation of gels based on this polymer. The evaluation of Agerite Resin 'D' was completed as was the comparison of Agerite Superlite and Wingstay 'T'. The general antioxidant study was also completed. The investigation of the possibilities of introducing structure into low crystalline polymers by change in processing techniques was continued. Task B—Balloon performance—The study of the relationship between flight performance and state of cure was continued. It was clearly shown that balloons cured under conditions which produce less than optimum physical properties will generally reach higher altitudes. As a result of this study, an 850-gram balloon was developed which is capable of consistently reaching altitudes of 100 000 feet by day or

night. It was also demonstrated that prolonged low temperature curing of balloons, which have already been cured to provide optimum physical properties, results in inferior flight performance. Author

N65-16637# Sheffield Univ. (England).
A STUDY OF THE FUNDAMENTAL PRINCIPLES OF THE VISCOELASTIC PROPERTIES OF POLYMERS Report No. 2
J. D. Willis Dec. 1964 49 p refs
(HIC-53)

Physical transitions that occur in high polymeric materials, and the temperatures at which they occur, were investigated to gain understanding of the mechanical properties of these materials. The transitions studied include crystal melting, first order crystalline transitions, glass transitions, and secondary glass transitions. The relations between damping terms associated with various techniques of dynamic mechanical testing of polymers are discussed, and the use of mechanical models in the study of the viscoelastic properties of polymers is illustrated. The relation between the molecular structure and the dynamic properties of polymers is outlined. The effects of molecular weight, cross-linking, plasticization, and copolymerization are given, and the properties of polyblends and graft polymers are discussed. D.S.G.

N65-16765# Houghton (E. F.) and Co., Philadelphia, Pa.
DEVELOPMENT OF FIRE RESISTANT WATER BASED HYDRAULIC FLUIDS
Philip Rakoff, G. John Colucci, and Robert K. Smith 27 Nov. 1964 26 p
(Contract NObsr-90269)
(BMR-4; AD-608564)

The study of ignition inhibitors for water glycol fluids was continued, with emphasis on noncrystalline compounds. A search for better screening methods of corrosion inhibitor system in the target fluids was started. One candidate fluid was examined with respect to the target specification. Author

N65-16806# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
MECHANICAL PROPERTIES OF FIBROUS COMPOSITES Annual Report
B. Walter Rosen, Norris F. Dow, and Zvi Hashin (Pennsylvania Univ.) 30 Jul. 1963 154 p refs
(Contract NASw-470)
(NASA-CR-60668) OTS: HC $5.00/MF $1.00

Relationships between the properties of fibrous composites and the properties of their constituents are evaluated. Bounds and expressions for the effective elastic moduli of materials reinforced by hollow circular fibers are derived by a variational method. Exact results are obtained for hexagonal arrays of identical fibers, and approximate results are obtained for random arrays of fibers, which may have unequal cross sections. Typical numerical results are obtained for technically important elastic moduli. The tensile strength of composite materials consisting of a ductile matrix uniaxially reinforced by high-strength high-stiffness fibers are analyzed. The application of the analysis is demonstrated by using glass-fiber strength data in an evaluation of glass-fiber-reinforced composites. Supporting experimental studies are described. These include measurements of strength and stiffness of particle-reinforced matrix materials and tensile testing of thin fibrous composites containing only a single layer of fibers. Author

N65-16831*# Melpar, Inc., Falls Church, Va.
TESTING OF ABLATION MATERIAL: PRELIMINARY DATA CONCERNING NONDEGRADED ABLATION MATERIALS, NOS. 1, 2, 3, AND 4 Technical Progress Letter No. 4, 10 Jan.–10 Feb. 1964
L. K. Eliason, D. H. Rice, E. L. Sanford, and T. L. Poe [1964] 62 p
(Contract NAS1-2977)
(NASA-CR-53658) OTS: HC $3.00/MF $0.75

Preliminary data are presented for the thermophysical properties of four ablative materials in the nondegraded state. The data on specific heat are complete. Some data points remain to be measured for thermal conductivity, thermal expansion, tensile strength, and compressile strength. The information included defines the characteristics of the materials over most of the usable temperature range. A separate test method report is also included, which defines the test techniques used to obtain the reported data. D.E.W.

N65-16912# American Oil Co., Whiting, Ind. Research and Development Dept.
DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUID Bimonthly Progress Report, Jun. 1–Aug. 1, 1964
K. R. Bunting, A. M. Dobry, E. A. Swakon, P. C. Vienna, and L. W. Mixon [1964] 9 p refs
(Contract NObs-90267)
(BMPR-2; AD-608631)

The objective is the development of a water-base hydraulic fluid which (1) yields a fire-resistant nonaqueous residue, (2) is compatible with construction materials and sea water contamination, (3) satisfactorily lubricates shipboard pumps, (4) presents no unusual storage or handling problems, and (5) exhibits no toxicological hazards under conditions of use. Attempts to prepare polymers of unsaturated organic acids of phosphorus, having molecular weights sufficiently high to thicken water, have not been successful. Low-density polyethylene can be chlorophosphorated by reaction with phosphorus trichloride and oxygen. Based on preliminary data, hydrolysis and neutralization results in products which contain about 15% phosphorus show considerable promise as thickeners. Author

N65-17156# Wyandotte Chemicals Corp., Mich.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Quarterly Progress Report, 1 Sep.–30 Nov. 1964
S. L. Axelrood and W. J. Lajiness 30 Nov. 1964 26 p
(Contract DA-20-018-ORD-24883)
(QPR-7; AD-610223)

A series of urethane–urea elastomers were prepared from an 11 000-molecular weight triol and a 4700-molecular weight diol. These had lower properties than similar elastomers prepared from higher molecular weight polyethers. Elastomers prepared with a variety of monomeric diols and triols were compared to similar elastomers prepared with trimethylolpropane. The latter elastomers had better combinations of properties. Effect of incorporating extractable plasticizer was also investigated. This tended to improve oil resistance and low temperature properties. Author

N65-17226# Allied Research Associates, Inc., Concord, Mass.
PHOTOELASTIC SIMULATION OF A SEISMIC RADIATION SOURCE Final Report
Ralph Papirno and Herbert Becker 15 Nov. 1964 42 p refs
(Contract AF 19(628)-4012; ARPA Order 292; Proj. Vela-Uniform)
(AFCRL-64-1009; AD-610515)

A two-phase photoelastic investigation of the radiation field surrounding a simulated seismic source was performed. In the first phase, a method was developed for producing a shear fracture in a simulated shear fault in a urethane photoelastic plate model. The limited self-healing ability of fractures in urethane rubber was exploited. High-speed motion pictures of the shear fracture process indicated that a slip-stick mode of fracture occurred prior to the opening of a finite width crack. In the second phase of the investigation, strobelasticity was employed to study the radiation pattern after shear impact. The isoclinic analysis and the derived stress trajectories indicated that both dilatational and distortional waves were present, and also indicated their propagation directions and relative velocities.
Author

N65-17244# Rock Island Arsenal Lab., Ill.
RADIATION AND OZONE INITIATED GRAFT COPOLYMERIZATION
J. W. Mc Garvey 13 Oct. 1964 15 p refs
(Rept.-64-3009; AD-610557) OTS: $0.70

Radiation- and ozone-initiated graft copolymerization reactions were investigated for the synthesis of new, technologically useful elastomers. Significant grafting was observed for many of the various combinations of monomers and polymers investigated. Radiation-initiated vinylidene chloride-SBR, and ozone-initiated acrylonitrile-SBR graft copolymers are of particular interest since they exhibit improved oil resistance.
Author

N65-17397# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE DOUBLE REFRACTION OF RUBBER IN THE DEFORMED AND IN THE UNDEFORMED STATE
M. Kroeger 24 Sep. 1964 Transl. into ENGLISH from Kolloid-Z. (Darmstadt), v. 45, 1928 p 52–56
(RSIC-289; AD-607084)

Crude rubber becomes double refracting during storage. Longitudinal elongation leads to positive biaxial double refraction. The determination is unambiguous if it is possible to perform the observations in the direction of the stretching. In the case of vulcanized rubber only positive uniaxial or biaxial double refraction can be considered. The lamellar deformation leads in all cases to weak negative biaxial double refraction.
Author

N65-17434# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE TENSILE MODULI OF PARALLEL FILAMENT COMPOSITES
John W. Melvin Oct. 1964 44 p refs
(Contract NOw-64-0178-d)
(T&AM-271; AD-456718)

The tensile modulus of silicone rubber was determined over a range from room temperature to 200° F. Knowledge of the modulus variation with temperature was used to evaluate the applicability of theoretical expressions for the longitudinal and transverse tensile moduli of a silicone rubber–glass filament composite which was tested under the same temperature conditions. The expression for the longitudinal modulus derived from a simple parallel model was in agreement with the observed experimental results; even when a moderate amount of catenary is present, the theory predicts the longitudinal modulus successfully. The tests for the transverse modulus of the composite showed a maximum effect of the matrix on the modulus when values for the matrix-filament modulus ratio were in the range of 4×10^{-5} to 4×10^{-3}. Analysis of the data was conducted in terms of the concept of effective matrix content and the associated effective matrix factor, f_e; although f_e is an empirical quantity, it is basically a measure of the interaction between matrix and reinforcement, and its apparent constancy over the useful content range may provide a possible design variable.
D.S.G.

N65-17452*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
STUDY FOR DEVELOPMENT OF ELASTOMERIC THERMAL SHIELD MATERIALS, 1 JULY 1963 to 1 JUNE 1964
C. M. Dolan Washington, NASA, Mar. 1965 115 p
(Contract NAS1-3251)
(NASA-CR-186) OTS: HC $4.00/MF $0.75

After various screening and evaluation phases, two material systems were selected, properties were generated, a thermostructural analysis was made, and a scale-up unit fabricated and thermal cycled. One of the material systems, a foamed phenyl silicone reinforced with aluminum silicate fibers in a discontinuous supporting matrix, met the performance criteria. The second material, a syntactic silicone foam filled with phenolic and silica microspheres in a discontinuous supporting matrix, was used in a composite with an underlay of an unsupported foamed phenyl silicone. This formulation met the performance criteria, except the extreme low temperature exposure in the scale-up thermal cycle. Modifications of these materials were tested in an ablation environment simulating the reentry conditions of a leading edge and control surface of a typical lifting reentry vehicle. The materials exhibited high heats of ablation combined with minimum shape change to indicate feasibility for this application.
Author

N65-17501# American Oil Co., Whiting, Ind. Research and Development Dept.
DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUID Bimonthly Progress Report, 1 Aug.–1 Oct. 1964
K. R. Bunting, A. M. Dobry, E. A. Swakon, P. C. Vienna, and L. W. Mixon [1964] 8 p
(Contract Nobs-90267)
(BMPR-3; AD-608630)

In the development of a water-base hydraulic fluid it was found that low-density polyethylene can be chlorophosphonated by reaction with phosphorus trichloride and oxygen. Hydrolysis and neutralization produce products which show considerable promise as thickeners. The product from 21 000-molecular-weight polyethylene, neutralized to a pH of 8.0 with sodium hydroxide, produces a fluid which (1) has the desired viscosity, (2) is shear stable in tests, (3) can be rendered noncorrosive to iron, copper, silver braise, aluminum, and zinc by the addition of corrosive inhibitors, (4) has no deleterious effect on Buna N rubber, (5) is compatible with 10% synthetic sea water, (6) is nontoxic and nonirritating, and (7) appears to produce a nonaqueous residue having satisfactory flammability characteristics.
Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-16344*# Brown Univ., Providence, R. I.
SUFFICIENT CONDITIONS FOR STABILITY AND INSTABILITY OF AUTONOMOUS FUNCTIONAL-DIFFERENTIAL EQUATIONS

Jack K. Hale [1965] 43 p refs Submitted for Publication
(Grants NGR-40-002-015; AF-AFOSR-693-64; Contract DA-31-124-ARO-(D)-270)
(NASA-CR-60587) OTS: HC $2.00/MF $0.50

The concept of the Lyapunov functionals is applied to determine sufficient conditions for the stability of autonomous functional differential equations. Stability and instability theorems for autonomous systems similar to some results of LaSalle's theorem on ordinary differential equations are discussed, and the extension of these results to infinite time lag is presented. G.G.

N65-16412# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SOME APPLICATIONS OF FRACTIONAL INTEGRATION Mathematical Note No. 316
Arthur Erdélyi (California Inst. of Tech., Pasadena) Aug. 1963 26 p refs
(DI-82-0286)

The usefulness of fractional integrals in applied mathematics is demonstrated by presenting some of their applications to axially symmetric potential problems, and showing that in this manner both general theorems and explicit solutions of concrete problems can be obtained. The application of fractional integrals to a mixed boundary-value problem of the type occurring in the electrified disk is presented, and the solution corresponds to the solution by fractional integration of the equivalent problem in dual integral equations. G.G.

N65-16414# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
HEIGHTS OF CONVEX POLYTOPES Mathematical Note No. 337
Victor Klee (Washington Univ., Seattle) Feb. 1964 23 p refs
(D1-82-0330)

Though phrased in geometric terms, this report is concerned with the comparative efficiency of various pivot rules for the simplex method of linear programing, in which one seeks to maximize a linear objective function ψ by moving along the edges of the feasible region. The following three rules are considered: (1) From the vertex v, survey the adjacent vertices until a vertex w is found for which $\psi(v) < \psi(w)$; then move to w and continue the process. (2) From the vertex v, survey all of the adjacent vertices in order to find one, say w, at which ψ has the greatest value; then move to w and continue the process. (3) From the vertex v, survey all of the adjacent vertices in order to find one, say w, for which the slope $(\psi(w) - \psi(v))/\| w - v\|$ has the greatest value; then move to w and continue the process. In each case, the main consideration is the maximum number of moves which may be required when the feasible region is subjected to various restrictions on its structure, its dimension d, the number f_0 of its vertices, or the number f_{d-1} of its $(d-1)$-faces. Author

N65-16419# Stanford Univ., Calif. Dept. of Mathematics
AN AXIOMATIC TREATMENT OF PAIRS OF ELLIPTIC DIFFERENTIAL EQUATIONS Technical Report No. 31
Peter A. Loeb Aug. 1964 100 p refs
(Contract DA-31-124-ARO(D)-170)
(AROD-1323-25; AD-455369)

Beginning with three simple axioms, an axiomatic setting, in which many of the classical results of the theory of elliptic differential equations can be established, was developed. This setting is used to generalize the results pertaining to the classification of open Riemann surfaces, and to the existence of an isometric isomorphism from the class of bounded solutions of one elliptic differential equation into the class of bounded solutions of another when a certain "majoring" relationship exists between the two equations. Author

N65-16469# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN APPROACH TO GIANT-STEPPING Group Report 1964-70
E. Weiss 23 Nov. 1964 14 p refs *Its* Group Rept.-1964-70
(Contract AF 19(628)-500)
(AD-608758) OTS: $1.00

In certain situations there is a need for a binary sequence with extremely long period (to be measured in years, e.g.) with equidistribution of zero and ones (and for pairs, triples, etc. insofar as possible) and having an additional property that may be called giant-stepping. One procedure for handling this problem is described; the approach is based on the assumption that it is neither feasible nor desirable to set up way stations (whether pre-programed or not) along the way. Author

N65-16494*# Martin Co., Baltimore, Md. Research Inst. for Advanced Study
UNBOUNDED SOLUTIONS OF A SECOND-ORDER DIFFERENTIAL EQUATION WITH NON-NEGATIVE DAMPING
G. R. Morris [1964] 23 p
(Contracts NASw-718; AF 49(638)-1242)
(NASA-CR-56113) OTS: HC $1.00/MF $0.50

Given is the equation

$$\ddot{x} + x = -8 \sin 3t,$$

which has a one-parameter family of unbounded solutions. For various conditions, solutions are derived and lemmas proved. E.E.B.

N65-16495*# Kent State Univ., Ohio.
STOCHASTIC MODELS FOR MULTI-VALUED, MULTI-DIMENSIONAL RELATIONS Semiannual Status Report, Oct. 15, 1963–Apr. 15, 1964
Triloki N. Bhargava 16 Apr. 1964 20 p refs
(Grants NsG-568)
(NASA-CR-56157) OTS: HC $1.00/MF $0.50

The linkup between directed graphs (digraphs) and point-set topology is reported. To be able to exploit fully the topological spaces associated with digraphs, it is necessary to find methods for counting topologies which in turn will enable one to describe probability distributions on the appropriate space. Such a development is included. The most general way of describing a graph and a digraph is discussed. Random graphs and digraphs, information theory and theory of graphs, historical survey of the theory of digraphs, and digraphs and a weak metric concept are additional subjects covered in the report. E.E.B.

N65-16500*# Case Inst. of Tech., Cleveland, Ohio.
[SPECIAL FUNCTIONS AND SOLUTION REPRESENTATIONS OF PARTIAL DIFFERENTIAL EQUATIONS] Semiannual Progress Report
Louis R. Bragg 1 May 1964 4 p refs
(Grant NsG-544)
(NASA-CR-56249) OTS: HC $1.00/MF $0.50

The aims and status of research on the following topics are discussed: *The Radial Heat Polynomials and Solution Representations of Radial Heat Flow; Expansions of Solutions of Initial Value Problems* (on finite intervals or bounded regions); and *Polynomial Decompositions of Solutions of a Class of Initial Value Problems* (in unbounded regions). D.S.G.

N65-16521# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
MINIMAL INTERCHANGES OF (0,1)-MATRICES AND DISJOINT CIRCUITS IN A GRAPH Mathematical Note No. 323

David W. Walkup Sep. 1963 16 p refs
(D1-82-0305)

It is shown that the minimal number of interchanges necessary to transform one (0,1)-matrix into another equivalent one may be computed from the maximal number of edge-disjoint circuits in a bipartite graph derived from the difference of the matrices. This partially answers a question raised by Ryser. Two (0,1)-matrices are said to be equivalent if their difference has zero row and column sums. They are said to differ by an interchange if they are equivalent and their difference is zero except for a 2×2 minor. Author

N65-16636# RAND Corp., Santa Monica, Calif.
ON CONFORMALLY RELATED METRIC SPACES ONE OF WHICH ADMITS AN IRROTATIONAL ISOMETRY
Dominic G. B. Edelen 24 Nov. 1964 19 p refs
(P-3019; AD-608872)

Let H_n denote an n-dimensional ($n > 2$) hyperbolic-normal metric space with fundamental differential form

$$ds^2 = h_{AB}\, dx^A\, dx^B, \text{ with } A, B = 0, 1, \ldots, n-1.$$

The hyperbolic-normal condition is reflected by the fact that the signature of $((h_{AB}))$ is $2 - n$. As is customary, a vector field on H_n, with components V^A, is referred to as time-like, space-like, or null, when $V^A V^B h_{AB}$ is greater than, less than, or equal to zero, respectively. The conformally related space C_n is introduced and defined, and lemmas and relations between the two spaces are stated and proved. The Ricci tensor of C_n is discussed, and a number of theorems are stated and proved. The irrotational isometry in H_n, $U^A \omega_{A} = 0$, is considered briefly, and two theorems are given with short proofs. D.E.W.

N65-16664# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
MAXIMUM LIKELIHOOD ESTIMATION FOR DISTRIBUTIONS WITH MONOTONE FAILURE RATE Mathematical Note No. 336
Albert W. Marshall and Frank Proschan Feb. 1964 21 p refs
(D1-82-0329)

Using the idea of maximum likelihood, an estimator for a distribution function possessing an increasing (decreasing) failure rate is derived, as well as corresponding estimators for the density and the failure rate. It is shown that these estimators are consistent. Author

N65-16670# Stanford Univ., Calif. Systems Theory Lab.
DYNAMIC PROGRAMMING WITH CONTINUOUS INDEPENDENT VARIABLE Technical Report No. 6302-6
R. E. Larson Apr. 1964 107 p refs
(Contract Nonr-225(24))
(SEL-64-019; AD-443041)

In this study a computational procedure for solving optimal control problems, called dynamic programing with continuous independent variable, was developed. This procedure has a high-speed memory requirement several orders of magnitude less than that of conventional dynamic programing, but it still retains the general applicability and other desirable features of the conventional method. In a typical example the reduction in high-speed memory requirement is from 10^9 to about 100 locations. This technique was applied in a computer program which calculates minimum fuel trajectories for supersonic (Mach 3) aircraft under a variety of conditions and constraints. The basic program can be used both for a detailed evaluation of an aircraft design and for real-time control of an aircraft. Computation of the optimal bounded control of linear plants has also been studied in detail, and a number of other possible applications are indicated. Author

N65-16702 European Organization for Nuclear Research, Geneva (Switzerland). Data-Handling Div.
A DEFINITE INTEGRAL WITH MODIFIED BESSEL FUNCTIONS
K. S. Kölbig 14 Dec. 1964 35 p refs
(CERN 64-51)

Some properties of the function

$$U(s, r) = \int_0^\infty e^{-st}\, \frac{I_0(rt)\, K_0(t) - I_0(t)\, K_0(rt)}{K_0^2(t) + \pi^2 I_0^2(t)}\, \frac{dt}{t}$$

are discussed. Short tables are given for $U(s,r)$ and for

$$W_0(s) = \int_0^\infty e^{-st}\, \frac{dt}{t\,[K_0^2(t) + \pi^2 I_0^2(t)]}$$

and

$$W_1(s) = \int_0^\infty e^{-st}\, \frac{I_0(t)}{K_0^2(t) + \pi^2 I_0^2(t)}\, \frac{dt}{t}.$$

Author

N65-16713# Liege Univ. (Belgium).
DIFFERENTIAL EQUATIONS WITH FIXED CRITICAL POINTS
F.J. Bureau Repr. from Ann. Mat. Pura Appl., ser. IV, vol. LXIV 1964 p 229–364 refs Sponsored in part by AF
(AFOSR-64-2271; AD-608752) OTS: $4.00

The object of this study is to determine all the differential equations of the form $\dot{y} = R(\dot{y}, y, x)$ where R is a rational function of $\dot{y}$ and y, with analytic coefficients in x, whose general integral has no parametric critical points. Author

N65-16716# Stanford Univ., Calif. Dept. of Statistics
ADAPTIVE STATISTICAL PROCEDURES IN RELIABILITY AND MAINTENANCE PROBLEMS
J. L. Gastwirth and J. H. Venter 12 Oct. 1964 32 p refs
(Contract Nonr-225(52))
(TR-99; AD-608726)

The following problem was considered: A system with an exponential lifetime of a known distribution function F(t) is to be inspected at times $t_1, t_2, \ldots$. If inspection reveals that the system is inoperative, it is repaired or replaced; otherwise, nothing is done. The general problem is to choose the inspection plan, i.e., the sequence $t_1, t_2, \ldots$; in an optimal way in a suitable sense.

$$F(t) = \begin{cases} 0 & \text{if } t < 0 \\ 1 - e^{-\lambda t} & \text{if } t \geq 0 \end{cases}$$

Several adaptive or sequential inspection plans are proposed with $\lambda (> 0)$ an unknown parameter. These plans use information, as it becomes available through inspection, to estimate the unknown parameters λ. E.E.B.

N65-16755# Naval Missile Center, Point Mugu, Calif.
A RULE-OF-THUMB METHOD FOR OBTAINING MINIMUM VARIANCE ESTIMATES OF STANDARD DEVIATION FROM NORMAL DATA
M. Brown 7 Dec. 1964 17 p ref
(NMC-TM-64-68; AD-452575)

A rule-of-thumb method is derived for reducing a sample of statistically independent data, obtained from an unbiased, circular normal distribution, so as to yield an unbiased, minimum variance estimate of the standard deviation of the parent distribution. By establishment of a mathematical model, the concept of minimum variance is developed, and the rule-of-thumb approximation is derived. Sources of error are considered to determine the accuracy of the method employed. The computational technique provides an example of the empirical

establishment of a mathematical theorem which is valid over the intended range of its applicability, and which cannot be established in any other manner. It is suggested that contractual specifications for missile systems, which refer to circular error probable, be modified and replaced by corresponding specifications with respect to the radius of a circle containing 80% of the test shots. Author

N65-16781# RAND Corp., Santa Monica, Calif.
A SIMPLE PROBABILISTIC PROOF OF THE DISCRETE GENERALIZED RENEWAL THEOREM
Sidney C. Port Dec. 1964 13 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4330-PR; AD-608690)

It is asserted that, if $EX_1 > 0$, and if X_1 has an aperiodic distribution on the integers, then

$$\lim_{y \to +\infty} G(x,y) = (EX_1)^{-1}, \text{ and } \lim_{y \to -\infty} G(x,y) = 0$$

where we interpret $(EX_1)^{-1}$ to be 0 if $EX_1 = \infty$. By taking full advantage of the discreteness, a simple proof of this theorem is presented, using elementary probabilistic arguments. D.E.W.

N65-16827*# Emory Univ., Atlanta, Ga.
[DIFFERENCE EQUATIONS WITH VARYING DIFFERENCE INTERVALS AND DIFFERENCE EQUATIONS AND DIFFERENTIAL EQUATIONS WITH ALMOST PERIODIC COEFFICIENTS] Status Report, 1 Dec. 1963–1 Jun. 1964
Tomlinson Fort May 1964 18 p
(Grant NsG-545)
(NASA-CR-56355) OTS: HC $1.00/MF $0.50

First, putting rather weak restrictions on $q_1(z)$, $q_2(z)$, an intensive study has been made of the series

$$(1) \quad \sum_{n=1}^{\infty} c_n(q_1, q_2, \ldots) \frac{1}{(z + q_1(z))(z + q_2(z)) + \ldots + (z + q_n(z))}$$

A study is then made of difference equation (2). There is a general theory followed by applications of series (1).

$$(2) \quad p_0(z)\, y(z) + p_1(z) y(z + h_1(z)) + \ldots + p_n(z) y(z + h_n(z)) = R(z)$$

where $h_{j+1}(z) = h_1(z) + h_{j-1}(z + h_1(z))$,

$h_j(z) = r_j(z) + s_j(z)i$, $\quad 0 < r_j < r_{j+1} \to \infty$

and r(z) monotonically increasing with x. Author

N65-16839*# Rensselaer Polytechnic Inst., Troy, N. Y.
ANALYSIS OF PIECE-WISE LINEAR SYSTEMS BY THE METHOD OF INTEGRAL EQUATIONS
C. N. Shen and Hubert Wang [1962] 23 p refs
(Grant NsG-14-59)
(NASA-CR-51788) OTS: HC $1.00/MF $0.50

Analysis of piece-wise linear systems may require the solution of high-order linear, differential equations whose parameters are constants within a given region, but change into different constants for adjacent regions. The multiple regions of such a system may be identified with discrete intervals, and it is a simple matter to obtain the system response by the method of integral equations. These solutions are given in the form of convergent infinite series, the terms of which may be easily evaluated by a digital computer. The time interval of each region is found by substituting successive values of these truncated series until the required boundary conditions are satisfied. The method is applied to a third order type two system whose sustained oscillation, when subjected to dry friction, is to be eliminated by dead-zone compensation. Author

N65-16921# System Development Corp., Santa Monica, Calif.
ON THE CONCEPT OF FIFOV IN QUEUES AND A DETAILED STUDY OF THE CASE OF A POISSON QUEUE WITH TWO HETEROGENEOUS SERVERS
B. Krishnamoorthi 16 Sep. 1964 36 p refs
(SP-1729/001/00; AD-608576)

In several queuing situations the order in which the units depart is not the same as the order in which they arrive at the system. This phenomenon is called the Violation of the First-In, First-Out Principle, (FIFOV). A quantitative study of FIFOV is of operational importance in tandem queuing and many other situations. A general discussion is given of the concept and study of a special aspect of FIFOV in a Poisson queue (Poisson input and exponential service times) with two heterogeneous servers working in parallel. In this connection the time-dependent distribution of the output in an M/M/1 queue was obtained. Defining X as the number of customers superseding a customer taking service from the slower channel one obtains the distribution and the first two moments of X under a queue discipline that is a modification of the classical one. A criterion of optimality is suggested and a numerical illustration is given. Author

N65-16922# Stanford Univ., Calif. Dept. of Statistics
ON SAMPLED DATA FEEDBACK CONTROL
Yukio Suzuki 15 Oct. 1964 54 p
(Contract Nonr-225(52))
(TR-100; AD-608732)

Special types of random functions as output of a manufacturing process without control are considered. Three types of control are considered for best performance—the proportional control, the integral control, and a mixture of both. It is concluded that a proportional or an integral control procedure, for which performance is better than that of the mixed procedure, always exists. Tables are included for both proportional control and integral control. E.E.B.

N65-16947 Arizona Univ., Tucson.
SOME TOPICS IN DIFFERENTIAL ALGEBRA
Oma Hamara [1964] 31 p refs Prepared jointly with Pacific Union Coll.
(Grant Nonr(G)-00039-64)
(AD-608651)

The possibility that a certain definition of differentiation would reveal interesting structure, and simplify the existing theory of differential algebra (at least in the case of characteristic $p > 0$), has been investigated. Some years ago Teichmuller and others defined and studied in some detail the consequences of a definition of differentiation which modified the usual definition by a multiplicative constant in the case of characteristic zero, and eliminated some of the triviality in the case of characteristic greater than zero. Since then much work has been done in differential algebra and a consideration of how the theory may go under this alternate form of differentiation was in order. Author

N65-17014# Wisconsin Univ., Madison. Mathematics Research Center
COMPLEMENTARY VARIATIONAL PRINCIPLES FOR BOUNDARY VALUE PROBLEMS I: BASIC PRINCIPLES, WITH AN APPLICATION TO ORDINARY DIFFERENTIAL EQUATIONS
B. Noble Nov. 1964 32 p refs
(Contract DA-11-022-ORD-2059)
(MRC-473; AD-610442)

A general variational principle, and two complementary variational principles are developed for the simultaneous equations

$$T\Phi = \partial W(x, \Phi, u)/\partial u,$$

$$T^*u = \partial W(x, \Phi, u)/\partial \Phi,$$

where T, T* are linear operators and T* is the adjoint of T. The resulting formulas are of wide applicability and include most of the complementary variational principles which occur in applied mathematics. The implications of the variational principles are worked out in some detail when $T = d/dx$, $T^* = -d/dx$, including a discussion of the extra terms required to deal with general boundary conditions. Author

N65-17015# Wisconsin Univ., Madison. Mathematics Research Center

A FIX-POINT THEOREM WITH ECONOMETRIC BACKGROUND. PART I: THE THEOREM

Herman O. A. Wold Jan. 1965 20 p refs

(Contract DA-11-022-ORD-2059)

(MRC-529; AD-610452)

The theorem provides a new approach to a problem that has originated in econometrics, namely the statistical estimation of parameters of so-called interdependent systems. The problem is formulated generally, as one of orthogonal projection in Hilbert vector space, an interpretation based on the definition of interdependent systems in terms of conditional expectations. The subspace on which the vectors are projected is spanned by vectors some of which are given, whereas others—and this is a nonlinear feature of the problem—are unknown and to be determined by the projection. The problem is solved by an iterative least squares procedure that rests on a new application of the principle of contraction mapping. The fixed-point theorem and the ensuing iterative procedure are presented. Illustrations and comments take up three specifications of the components of the given vectors y, z: (1) as vectors in Euclidean space R_h; (2) as random variates, making y, z a multivariate random distribution; (3) as statistical data, interpreted as a sample from the distribution under (2). Extensions in various directions are briefly outlined. It is emphasized that the assumptions of the approach broaden the scope of interdependent systems. Author

N65-17016# Wisconsin Univ., Madison. Mathematics Research Center

THE CHARACTERIZATION OF THE SOLUTION SET FOR GENERALIZED REDUCED MOMENT PROBLEMS AND ITS APPLICATION TO NUMERICAL INTEGRATION

E. B. Cobb and Bernard Harris Dec. 1964 22 p refs

(Contract DA-11-022-ORD-2059)

(MRC-531; AD-610454)

The solution sets for the generalized reduced Hausdorff and Stieltjes moment problems are discussed, and some applications to numerical integration suggested. Author

N65-17017# Wisconsin Univ., Madison. Mathematics Research Center

AN ITERATIVE METHOD FOR OBTAINING DECREASING SEQUENCES OF UPPER BOUNDS OF FUNCTIONALS

V. Komkov Nov. 1964 10 p ref

(Contract DA-11-022-ORD-2059)

(MRC-534; AD-610456)

Numerical method for obtaining a monotonically decreasing sequence of upper bounds for functionals is given. The method extends the Kantorovich technique to an iterative procedure. Author

N65-17018# Wisconsin Univ., Madison. Mathematics Research Center

BOUNDS FOR SOLUTIONS OF A SYSTEM OF LINEAR PARTIAL DIFFERENTIAL EQUATIONS ON DOMAINS WITH BERGMAN-SILOV BOUNDARY

Josephine Mitchell Dec. 1964 21 p refs

(Contract DA-11-022-ORD-2059)

(MRC-535; AD-610457)

Bergman has given an integral formula for the solutions of the differential system $\delta^2\psi/\delta z_j \delta \bar{z}_j = F_j(z_j, \bar{z}_j)\psi$ $(j = 1,2)$, where z_1, $\bar{z}_1$, z_2, $\bar{z}_2$ are independent complex variables and F_j are entire functions of the indicated variables. Assuming that the solutions Re ψ are defined on a domain $M^4 \subset$ the space C^2 of two complex variables with a Bergman–Silov boundary D^2, bounds are obtained for Re ψ on $A^2 \cap M^4$, where A^2 is an analytic surface which (1) does not intersect D^2, (2) intersects D^2 in a finite number of points. An extension of the Schottky inequality due to Ahlfors is used in the derivation of the bounds. Author

N65-17026# Harvard Univ., Cambridge, Mass. Cruft Lab.

A STUDY OF CIRCULAR ARRAYS. 5: TABLES OF E(h,z), C(h,z), S(h,z) FOR CIRCULAR ARRAYS OF UP TO 5 ELEMENTS

Richard B. Mack and Evelyn W. Mack 1 May 1963 61 p refs

(Contract Nonr-1866(32))

(TR-385; AD-413561)

Tables of the integrals $E(h,z) = \int_{-h}^{h} \frac{e^{-j\beta R}}{R} dz'$

$$C(h, z) = \int_{-h}^{h} \cos \beta z' \frac{e^{-j\beta R}}{R} dz' \quad S(h, z) = \int_{-h}^{h} \sin \beta |z'| \frac{e^{-j\beta R}}{R} dz'$$

where $R = \sqrt{(z - z')^2 + b^2}$ distances between antennas (b), are given for values of b applicable to circular arrays of up to five antennas equally spaced about a circle. Values good to five decimal places are given for the antenna half-length, $h/\lambda = 1/4, 3/8, 1/2, 5/8$, and $z/\lambda = h/\lambda, h/\lambda - 1/4$, and 0, where z/λ is the distance along the antenna in wavelengths. The integrals for an isolated antenna of radius $a/\lambda = 0.007022$ are given for $0.1910 \leq h/\lambda \leq 0.7460$. Author

N65-17123# Wisconsin Univ., Madison. Mathematics Research Center

THE SPECTRA OF INFINITELY OSCILLATING POTENTIALS II

J. B. Mc Leod Sep. 1964 11 p refs

(Contract DA-11-022-ORD-2059)

(MRC-514; AD-607827)

The paper studies the spectrum of the differential equation

$$\frac{d^2y}{dx^2} + \{\lambda - q(x)\}\, y = 0 \quad (0 \leq x < \infty),$$

where $q(x) = h(x)g(x)$ and, roughly, $h(x)$ is an increasing function and $g(x)$ is periodic. With various smoothness conditions on $h(x)$, $g(x)$, the spectrum associated with the above equation, and a homogeneous boundary condition at $x = 0$ are proved to be discrete, with limits of $\pm\infty$. This improves an earlier result by removing an awkward extra restriction. The result applies to functions of the type $x^\alpha \sin x$ $(\alpha > 0)$. Author

N65-17161# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.

TABLES OF ELLIPTIC INTEGRALS OF THE FIRST, SECOND AND THIRD KIND

Henry E. Fettis and James C. Caslin Dec. 1964 99 p refs

(ARL-64-232; AD-610612)

This report contains the following:
(1) tables of

$$F(\Phi,k) = \int_0^{\Phi} \frac{d\theta}{\sqrt{1-k^2\sin^2\theta}}$$

(elliptic integral of the first kind) and

$$E(\Phi,k) = \int_0^{\Phi} \sqrt{1-k^2\sin^2\theta}\ d\theta$$

(elliptic integral of the second kind)

as functions of the modulus (k) and modulus squared (k^2) for values of the amplitude ranging from $\Phi = 5°$ to $\Phi = 90°$, inclusive, and values of k and k^2 between 0 and 1.0;

(2) tables of the elliptic integral of the third kind

$$\Pi(\Phi,\alpha^2,k) = \int_0^{\Phi} \frac{d\theta}{(1-\alpha^2\sin^2\theta)\sqrt{1-k^2\sin^2\theta}}$$

The ranges of k and Φ are as in (1), while the range of α^2 extends from $\alpha^2 = -1.0$ to $\alpha^2 = +1.0$. Author

N65-17164# Wisconsin Univ., Madison. Mathematics Research Center
ON THE BRIOT AND BOUQUET THEORY OF SINGULAR POINTS OF ORDINARY DIFFERENTIAL EQUATIONS
Walter Strodt Sep. 1964 105 p refs
(Contract DA-11-022-ORD-2059)
(MRC-508; AD-610443)

The Briot and Bouquet equation (1) $A(x,y) + B(x,y)\ dy/dx = 0$ is treated in the case where A(x,y) and B(x,y) are polynomials in x and y, with $B(x,y) \neq 0$. It is shown that if $A(x,0) \neq 0$, then (1) always has at least one solution y_0 which is asymptotically equivalent, in a sectorial neighborhood of ∞, to a function of the form $cx^q(\log x)^r$ with q and r rational numbers. The same result is found for the generalized equation (2) $A(x,y) + B(x,y)(dy/dx)^n = 0$ where n is an arbitrary positive integer. The result obtained for (2) is extended by generalizing the functions of x which appear as coefficients in (2). Additional precision is obtained by verifying that the asymptotic relation $y_0 \sim cx^q(\log x)^r$ holds in a very stringent sense. An analogous existence result is found for a broad class of equations of the form (3) $P(x,y,dy/dx) = 0$ where P is a polynomial in y and dy/dx, with coefficients polynomials in x, or more general functions of x. Author

N65-17166# Wisconsin Univ., Madison. Mathematics Research Center
TWO-POINT PROBLEMS FOR NON-LINEAR SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS
W. J. Coles and T. L. Sherman Aug. 1964 15 p refs
(Contract DA-11-022-ORD-2059)
(MRC-513; AD-610444)

This paper considers the differential equation $y'' + F(t,y,y') = 0$ together with one of the boundary conditions $y(a) = A$ and $y(b) = B$, $y(a) = A$ and $y'(b) = B$, $y'(a) = A$ and $y(b) = B$. Under appropriate conditions on F, it is well known that, for fixed a, a unique solution exists if $b - a$ is small enough. The question of a bound for $b - a$ continues to be of interest. Techniques are developed which provide some insight into previous proofs and give improvements of known results. In some cases the results can be interpreted as disconjugacy or nonoscillation theorems. Author

N65-17170# Wisconsin Univ., Madison. Mathematics Research Center
ON LINEAR RELATIONS BETWEEN ROOTS OF UNITY
Henry B. Mann Oct. 1964 20 p ref
(Contract DA-11-022-ORD-2059)
(MRC-TSR-524; AD-610448)

A relation

$$\sum_{\nu=1}^{k} a_\nu \zeta_\nu = 0$$

where the a_ν are positive integers and the ζ_ν are roots of unity is called a k-sided polar rational polygon (abbreviated prp.) A prp is called minimal if

$$\sum_{\nu=1}^{k} b_\nu \zeta_\nu = 0,\ a_\nu \geq b_\nu \geq 0$$

implies that either $a_\nu = b_\nu$ for all ν or $b_\nu = 0$ for ν. It is shown that for each k there is only a finite number of minimal k-sided prp's. All minimal k-sided prp's are enumerated for $k \leq 7$. Author

N65-17171# Wisconsin Univ., Madison. Mathematics Research Center
UPON SYSTEMS OF RECURSIONS WHICH OBTAIN AMONG THE QUOTIENTS OF THE PADE TABLE
P. Wynn Nov. 1964 17 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-526; AD-610449)

A simple relationship between five contiguous entries in the Padé table is derived. Properties of this relationship are discussed. Author

N65-17174# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A METHOD OF SOLVING SYSTEMS OF NONLINEAR FINITE-DIFFERENTIAL EQUATIONS OF PLATE BENDING
M. S. Kornishin and D. A. Kasimova 8 Jan. 1965 12 p refs Transl. into ENGLISH from Tr. Konf. po Teorii Platin i Obolochek (Kazan), 1961 p 191–198
(FTD-TT-64-422/1; AD-610322)

A method is presented for solving systems of nonlinear differential equations of plate bending, based on the use of a general iteration method in combination with an extrapolation method for the obtainment of zero approximation roots. Problems of greater bends, and of a square plate with fastened hinge and rigidly fitted edges exposed to the effect of a uniformly distributed load applied to a small area at the center are solved. E.E.B.

N65-17286*# Michigan Univ., Ann Arbor.
SOME EXPLICIT RESULTS IN MULTIVARIATE PREDICTION THEORY
F. J. Beutler [1963] 18 p refs Presented at the 6th Midwest Symp. on Circuit Theory, Madison, Wis., 6–7 May 1963
(Grant NsG-2-59)
(NASA-CR-60778) OTS: HC $1.00/MF $0.50

For a certain class of multivariate random processes, called wide-sense Markov processes, the minimum mean-square error linear prediction and estimation problem is solved in terms of explicit formulas. These continue to apply when only irregular samples of the process are available, or the optimum filter is constrained to have finite memory. A complete characterization of these processes is obtained; a process is shown to be wide-sense Markov if, and only if, its covariance matrix satisfies a specified functional equation. The output of a system described by a (possibly time-varying) matrix-vector equation forced by multivariate white noise is shown to be wide-sense Markov. Prediction and estimation optima are computed for the output of such a system. Author

N65-17351# Mathematica, Inc., Princeton, N. J.
ON FINDING INTEGER SOLUTIONS TO LINEAR PROGRAMS
M. L. Balinski 1 May 1964 78 p refs
(Contract DA-31-124-ARO(D))-31)
(AROD-4087-1; AD-606708)

A review of some uses and potential applications of integer programing is presented together with general remarks on the methods. The known sufficient conditions which assure that a linear program has optimal integer solutions are also reviewed. The integer programing algorithms of Gomory are developed and related to the Euclidean algorithm. An approach to the mixed integer problem is considered. Computational experience in integer programing is summarized, and reasons for erratic success are discussed. D.S.G.

N65-17352# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE THEORY OF LINEAR DIFFERENTIAL EQUATIONS WITH PERIODIC COEFFICIENTS AND TIME DELAY
S. N. Shimanov 25 Mar. 1964 15 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 27, no. 3, 1963 p 450–458
(FTD-MT-63-272; AD-605912)

A system is presented of linear differential equations with periodic coefficients and aftereffect (delay), for systems of automatic regulation. It was shown that spectrum of operator of monodromy does not depend on t_0 and determined symptotic stability or instability of motion $x = 0$. A conjugate system of differential equations is constructed, and a clear expression is given of the first integrals of the considered system through solution of the conjugate system. The connection between the spectra of operators of monodromy of initial and conjugate systems is explained, and the analytic form of eigenvectors and particular solutions of these systems, extended on the entire time axis from ∞ to $+\infty$, is obtained. Author

N65-17355# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME QUESTIONS CONNECTED WITH THE QUADRATIC COMPLEX
V. A. Manevich 16 Apr. 1964 7 p Transl. into ENGLISH from Nauchn. Dokl. Vysshei Shkoly, Fiz.-Mat. Nauki (Moscow), no. 5, 1958 p 38–39
(FTD-MT-63-309; AD-605588) OTS: $1.00

One method of construction of the tetrahedral (quadratic) complex is presented, and two interesting theorems connected with the quadratic complex are proven. Author

N65-17367# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ZEROES OF THE INDIVIDUAL SUMS OF A POWER SERIES
T. I. Krasnoshchekov 4 May 1964 11 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Moscow), no. 61, 1956 p 37–40
(FTD-MT-63-333; AD-602580)

A power series, $\sum_{n=0}^{\infty} a_n z^n = f(z)$ assuming $\overline{\lim}_{n\to\infty} |a_n|^{1/n} = 1$, and sequence of its individual sums, $\{S_n(z)\}$, are considered. Two theorems are proved, one which states that all points of circumference $|z| = 1$ are maximums for zeros of individual sums of series, and the other which states that if $\overline{\lim}_{n\to\infty} \left|\frac{a_n}{a_{n+1}}\right| = 1$, then the number of zeros of any function $S_n(z)$ in random sequence $\{S_n(z)\}$ is limited in region $|z| \geq 1 + \delta$, where δ is as small a number as desired. D.S.G.

N65-17372# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE EVALUATION FOR LYUSTERNIK-SHNIREL'-MAN CATEGORY
D. P. Grossman 25 May 1964 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 54, no. 2, 1946 p 109–112
(FTD-MT-63-323; AD-606743)

The theorem A—if the homotopic groups of the n-dimensional connected polyhedron K^n are trivial to the Kth order inclusively, then the category of this polyhedron does not exceed $[n/k+1] + 1$—is proved through the use of the following lemmas: (1) If homotopic groups of the n-dimensional connected polyhedron P^n are trivial to the Kth order inclusively and P^k is the k-dimensional frame of the polyhedron P^n, then $\text{cat}_{P^n} P^k = 1$. (2) Let (Po...Pn) be an n-dimensional simplex, (Po...Pm) and (Pm+1...Pn) $(0 \leq m < n)$ be two of its opposite edges, and let p be its point not belonging to any of these edges. Then there exists a unique straight line segment apb with ends a and b such that a E(Po...Pm) and b E(Pm+1...Pn). Points a and b continuously depend on point p. If p lies on the edge of the simplex $(P_o...P_n)$, then apb lies in that same edge. The proofs for these lemmas are given. Arriving at theorem B, let the homotopic groups of the n-dimensional connected polyhedron K^n to the Kth order inclusively be trivial. If $K^m (K+1 \leq m \leq n)$ is some subpolyhedron of polyhedron K^n and K^{m-k-1} is the $(m-k-1)$-dimensional frame of K^m, then in the expansion $K^m = U(K^{m-k-1}, \epsilon) + [K^m - U(K^{m-k-1}, \epsilon)]$ of polyhedron K^m into two closed sets, the set $A = K^m - U(K^{m-k-1}, \epsilon)$ has category 1, as long as $\epsilon > 0$. The proof for theorem B is given, from which the proof for theorem A easily follows. C.L.W.

N65-17424# Pittsburgh Univ., Pa.
AN INVESTIGATION OF THE APPLICATION OF MARKOV CHAIN MODELS TO THE DERIVATION OF OPERATING CHARACTERISTIC CURVES FOR SAMPLING PLANS
Charles R. Pennington (M.S. Thesis) 1964 208 p refs
(AD-603479)

In an investigation of the application of Markov chain models to the analysis of acceptance sampling plans, and the derivation of the operating characteristic curves which describe these plans, the following were considered: (1) a special Markov chain model developed to represent a single sampling plan for attributes with sample size N; (2) the study of a Markov representation of a particular type, an item-by-item sequential sampling scheme; (3) the computer programs which were developed for the two types; and (4) a brief comparison of the Markov approach to the traditional approach. Primary concern is with operating characteristic curve derivation, but interesting fringe benefits are also considered. Author

N65-17450# Columbia Univ., New York.
THE SPECTRAL SEQUENCE OF A POSTNIKOV SYSTEM
Donald W. Kahn [1963] 11 p refs
(Contract Nonr-266(57))
(CU-14-ONR-266(57)-M; AD-422971)

The purpose is to give some results concerning a spectral sequence that is associated with a space X and a given Postnikov system for X. This spectral sequence may be constructed in either homology or cohomology, with any group of coefficients. For homology with integral coefficients, the first (E_1) term contains all the homotopy groups of the space. The E_∞

term is a graded group associated with the homology (or cohomology) of the space. The differentials in the spectral sequence may be related to the k-invariants of the Postnikov system. In a certain restricted sense, the spectral sequence is natural. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-16652# Travelers Research Center, Inc., Hartford, Conn.
PROGRAM DESCRIPTIONS: SUPPLEMENT TO FURTHER INVESTIGATION OF NUMERICAL MODELS OF THE ATMOSPHERE BOUNDARY LAYER Final Report
Gerald C. Wickham and Marshall A. Atwater Jul. 1964 100 p refs
(Contract Cwb-10682)
(Rept.-7458-126A; AD-608628) OTS: $3.00

Two programs, Merge I and the data generation program, are discussed. Machine and operator requirements are given as program options and restrictions. The data generation program generates 6 hours of data on tape, with 1-minute time steps, and the input for the heat balance equations. The tape is input to Merge I which is the combination of previously reported heat balance, and diffusion model programs. E.P.V.

N65-16675# Chicago Univ., Ill. Dept. of the Geophysical Sciences
ON FORMATION AND INTENSIFICATION OF TROPICAL CYCLONES THROUGH LATENT HEAT RELEASE BY CUMULUS CONVECTION Final Report
H. L. Kuo Sep. 1964 78 p refs
(Contract CWB-WBG-13)
(AD-452377)

The effect of release of latent heat by deep cumulus convection in a conditionally unstable atmosphere on large-scale motions is investigated, and a method is devised to include this effect directly in the equations for large-scale flow. This method of including the latent heat input is applied to the hurricane formation problem by incorporating it into time-dependent, circular symmetric dynamic hurricane models, either in gradient-wind balance or unbalance. Numerical integrations of a two-level approximation of the balanced model have been carried out for two different formulations of the problem, with and without including a frictional radial flow separately, all starting from a hypothetical initial state characterized by a weak barotropic circular vortex with a maximum tangential velocity of 10 m/sec at a distance 141.2 km from the center. Author

N65-16780# Air Proving Ground Center, Eglin AFB, Fla.
A METHOD OF USING THE MEAN WINDS OF GROUND BASED LAYERS FOR COMPUTING WINDS ALOFT
Ralph R. Ruyle, Jr. Oct. 1964 26 p refs
(APGC-TR-64-79; AD-452462)

For many applications, mean winds are needed more than spot winds. This report shows that mean winds in two ground-based layers can be used to determine the mean wind in the elevated layer which is the difference of the two ground-based layers. Since most pibal wind observations can be thought of as observations of mean winds for a set of ground-based layers, a method is proposed in which such mean wind vectors are used throughout as the primary parameters. For observations of winds up to about 10000 ft, the proposed method will eliminate the need for some of the standard equipment used in pibal observations, viz, plotting boards and wind scales. Author

N65-17252# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLIMATE OF THE USSR, ISSUE 5, EASTERN SIBERIA
Ye. Ya. Shcherbakova 5 Oct. 1964 332 p refs Transl. into ENGLISH of the publ. "Klimat SSSR, Vypusk 5, Vostochnaya Sibir'" Leningrad, Gidrometeorologicheskoye Izd., 1961 p 1-300
(FTD-MT-63-338; AD-608302)

This book contains characteristics of the chief radiation and circulation factors, general characteristics of climate of Eastern Siberia, and a description of its individual elements (temperature, humidity, wind conditions, etc.) In addition, the role of the underlying surface in creating the climate is pointed out, and a climatic description of individual physicogeographic regions is given. The publication is intended for scientific workers and specialists in the fields of climatology, geography, and agriculture, as well as for school teachers, students of higher educational institutions, and a wide circle of readers. Author

N65-17277*# Stanford Research Inst., Menlo Park, Calif.
PRECIPITATION OBSERVATIONS FROM SATELLITES
A. S. Dennis [1963] 8 p refs Presented at the 44th Ann. Meeting of the Pacific Div., Am. Assoc. Advan. Sci., Stanford, Calif., 19 Jun. 1963
(Contract NASr-49(06))
(NASA-CR-60782) OTS: HC $1.00/MF $0.50

The suggestion that a weather radar or other precipitation-monitoring device be incorporated in future meteorological satellites is examined. Because of the variability of precipitation patterns, instantaneous observations of them cannot be used to locate fronts or low-pressure centers with any accuracy, or to identify fronts. Useful extrapolation of precipitation data is limited to 50 to 100 miles^3 in space and to about 1 hour in time. Consideration of this result, in the light of orbit mechanics, shows that a single satellite cannot serve as a satisfactory monitor of precipitation over the entire earth. Author

N65-17360# White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
WHITE SANDS MISSILE RANGE REFERENCE ATMOSPHERE, PART I
28 Jun. 1964 153 p refs
(IRIG-104-63; AD-451781)

Presented is an explanation of the basic data, computational procedures, and the resulting values tabulated for altitude intervals between mean sea level and 30-km altitude. Monthly and annual thermodynamic values and wind quantities are tabulated. The thermodynamic quantities are height (gpm), pressure (kg f m^{-2}), pressure (mb), temperature (° K), virtual temperature (° K), density (g m^{-3}), speed of sound (m sec^{-1}), relative humidity (%), and vapor pressure (mb) tabulated at 250-m intervals of geometric altitude. The wind quantities are scalar wind, zonal, and meridional component values (m/sec) for 11 cumulative percentage frequency levels tabulated at 1-km intervals from 0- to 27- or 30-km altitude. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-16760# Federal Aviation Agency, Atlantic City, N. J. Research Div.
OPERATION ACCORDION: NAVIGATIONAL ACCURACIES OF CIVIL JET AIRCRAFT OVER THE NORTH ATLANTIC, FEBRUARY 1962–SEPTEMBER 1963, VOLUME II Final Report
Irving Hirsch and Ronald Braff Dec. 1964 127 p
(RD-64-52, II)

Navigational accuracies over the North Atlantic during the period February 1962 through September 1963 are presented. The results are based upon data collected from approximately 5000 Accordion designated civil jet flights of 14 participant airlines. The measurements were made by four radars, viz, Gander, Goose, OSV Charlie, and Killard. In addition, considerable quantities of data were supplied by the airlines from Accordion flight logs. The administration of Operation Accordion comprised a condominium of the United States, the United Kingdom, and Canada. The primary purpose of the program was to provide information for decisions on current requirements for horizontal separation standards. Subordinate objectives included the procurement of information concerning the effects of different operational and external environments upon navigational accuracy. Author

N65-16841*# Battelle Memorial Inst., Columbus, Ohio.
SPACE-VEHICLE STABILIZED-PLATFORM GIMBAL-SYSTEM WEIGHT-REDUCTION STUDY. PHASE II: DESIGN OF SPHERICAL GIMBALS Summary Report, 1 Nov. 1962–30 Jun. 1963
J. E. Sorenson, T. J. Atterbury, and G. M. Mc Clure 2 Jul. 1963 39 p ref
(Contract NAS8-5701)
(NASA-CR-56147) OTS: HC $2.00/MF $0.50

An experimental approach was used to evaluate the spherical geometry, and a test gimbal was fabricated from aluminum and instrumented with strain gages. Various tests were conducted to determine the stresses and deflections that occur under the stimulated operational loading conditions. The resulting data were then used to design the spherical gimbals. The overall results show that spherical gimbals do not offer any weight saving over the proposed ring design, although they are lighter in weight than the ring design presently in use. Also, these spherical gimbals are much stiffer than either the present or proposed ring design, resulting in a system resonant frequency which should be in excess of 200 cps. Author

N65-16902# Federal Aviation Agency, Washington, D. C. ATC Development Div.
AIR TRAFFIC ACTIVITY FORECASTS CONUS, 1962–1980 Memorandum Report
Richard G. Brown, Jr. Apr. 1964 31 p
(RD-64-56)

Forecasts of active aircraft within the Continental United States from 1962 to 1980 are summarized in charts and tables. These forecasts describe current and future air-traffic activity over the Continental United States based on the most accurate information available. Information is presented in the following breakdowns: ownership, aircraft class, flights, flight rules, operations per flight, and flying hours. Author

N65-17334*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF STATISTICAL FILTER THEORY TO THE INTERPLANETARY NAVIGATION AND GUIDANCE PROBLEM
John S. White, George P. Callas, and Luigi S. Cicolani Washington, NASA, Mar. 1965 91 p refs
(NASA-TN-D-2697) OTS: HC $3.00/MF $0.75

The results of a study are presented wherein the Kalman filtering technique is applied to interplanetary navigation and guidance. The study considers the number, type, and timing of observations to be made, and the number and timing of velocity corrections. Both fixed time-of-arrival guidance and a periapse-control guidance are considered. The results are presented principally in terms of uncertainty on arrival, miss on arrival, and magnitude of velocity increments required. It is shown that the observations can be restricted to sextant measurements of the target planet, the launch planet, and the moon (when in the vicinity of the earth), and that daily observations are desirable during the major portion of the flight, with a much more frequent observation schedule at each end. Four velocity corrections should be made which, with a periapse-control guidance law, use a total of 30 m/sec velocity increment for each leg of the mission, resulting in a miss in the radius of periapse of 4 to 5 km. Author

N65-17387# Navy Electronics Lab., San Diego, Calif.
OMEGA NAVIGATION CAPABILITY BASED ON PREVIOUS MONITORING AND PRESENT PREDICTION ABILITY
E. R. Swanson 5 Jun. 1964 31 p refs
(NEL-1226; AD-605197)

Navigation with Omega depends on two factors: (1) the extreme phase stability of vlf signals propagated over long distances, and (2) the ability to predict the observed phase differences at any time of day and in any location. Phase differences at 10.2 kc/s recorded on 35 individual days were selected and compared with theoretical predictions using present phase velocities. The overall rms discrepancy between the observed and predicted phase differences for the 35 plots was 11.2 centilanes while the average rms discrepancy to be expected at an arbitrary location was 10.4 centilanes. It was concluded that a worldwide Omega system will provide fix information 24 hours a day, 365 days a year, to an accuracy of approximately 1 mile, except in arctic areas. G.G.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-16415# Phillips Petroleum Co., Idaho Falls, Idaho.
TRANSIENT TESTS OF THE FULLY ENRICHED, STAINLESS STEEL PLATE-TYPE, P CORE IN THE SPERT I REACTOR Data Summary Report

A. P. Wing Dec. 1964 65 p refs
(Contract AT(10-1)-205)
(IDO-17011) OTS: $3.00

This report presents the data obtained from the transient test series performed on the Spert I stainless steel plate-type P core. The tests consisted of step insertions of reactivity under varying conditions ranging from ambient temperature to ≈97° C and resulted in asymptotic reactor periods ranging from 6.0 sec to 4.0 msec. The experimental data obtained from each test are presented in both tabular and graphical form. The graphs include time-history plots of reactor power, fuel plate surface temperature, and pressure. Time-history composite graphs displaying fuel plate surface temperature as a function of reactor core position are included. Correlated graphs displaying test data as functions of asymptotic reactor period also are included. Author

N65-16445# Atomics International, Canoga Park, Calif.
URANIUM CARBIDE PROCESS DEVELOPMENT FOR THE ADVANCED SODIUM COOLED REACTOR
J. W. Carroll, D. H. Turner, and M. H. Binstock 1 Feb. 1965 28 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8887) OTS: $0.75

Hypostoichiometric uranium monocarbide is the reference fuel for the Advanced Sodium Cooled Reactor (ASCR) concept. A process development program, for developing an economical UF_6 to UC fuel slug manufacturing process, including synthesis, slug fabrication, and scrap recovery, and the UC synthesis process, utilizing carbothermic reduction of UO_2, are described. Commercially synthesized UC melt stocks have been evaluated. Carbon compositional control, which is largely related to melt stock quality, is the major problem in large-scale UC slug casting. Three alternate methods for process scrap recovery are discussed. Author

N65-16514# General Electric Co., Cincinnati, Ohio.
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 43, Part A
29 Jan. 1965 79 p refs
(Contract AT(40-1)-2847)
(GEMP-43A) OTS: $3.00

Work on the development of reactor materials progressed with the following studies: *Oxidation-Resistant Fuel Element Materials; High-Temperature Reactor Materials Fabrication; Effect of Radiation on High-Temperature Metals and Alloys; and High-Temperature Thermocouple and Electric Materials.* G.G.

N65-16784# Atomic Energy Commission, Washington, D. C. Div. of Safety Standards
LEAKAGE CHARACTERISTICS OF STEEL CONTAINMENT VESSELS AND THE ANALYSIS OF LEAKAGE RATE DETERMINATIONS
R. R. Maccary, J. J. Di Nunno, A. B. Holt, and G. A. Arlotto May 1964 107 p refs
(TID-20583) OTS: $4.00

The problem of leakage from nuclear reactor containment vessels is analyzed toward the establishment of a permissible leakage rate. The areas covered include leakage sources, flow phenomena through leaks, extrapolation and analysis of leakage rate test data, and evaluation of data to determine leaktightness reliability. R.C.M.

N65-16910# Radiation Research Associates, Inc., Fort Worth, Tex.
DIFFERENTIAL DOSE ALBEDOS FOR CALCULATION OF GAMMA-RAY REFLECTION FROM CONCRETE
M. B. Wells 30 Dec. 1964 56 p refs Work performed for Oak Ridge Natl. Lab.
(RRA-T46)

Differential dose albedos for gamma-ray reflection from concrete were derived from Monte Carlo calculations of gamma-ray scattering in air and concrete for source energies of 0.6, 1, 2, 4, and 7 Mev. Curves showing the albedo for reflection in the plane of incidence are presented for angles of incidence of $\theta_0 = 0°, 30°, 45°, 60°,$ and $75°$. At incident energies greater than 2 Mev, the computed dose albedos are smaller than those reported by Raso (also based on Monte Carlo), and those given by the Chilton–Huddleston formula. However, comparisons with experimental data for Cs^{137} and Co^{60} gamma rays, reported by others, indicate that the calculated albedos for these sources agree as well with the experimental data, as do calculations based either on the Chilton–Huddleston formula or Raso's Monte Carlo calculations. Author

N65-17023# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
RADIOLOGICAL ASPECTS OF SNAPTRAN 2/10A-3 DESTRUCTIVE TEST
O. L. Cordes, R. P. Bird, G. A. Dinneen, and J. R. Fielding Jan. 1965 79 p refs
(Contract AT(10-1)-205)
(IDO-17038) OTS: $3.00

Information for the aerospace safety program was acquired by subjecting a SNAP 2/10A reactor to a simulated water immersion accident which resulted in destructive disassembly of the reactor core. This report describes in detail an extensive monitoring grid used to monitor the radiological effects of the destructive excursion and subsequent release of fission products. An analysis of the data indicates that the direct radiation hazards were low, and that the only fission products released to the environment were less than 4 percent of the noble fission gases. Halogens that escaped from the fuel were retained in the environmental water. Author

N65-17029# Atomics International, Canoga Park, Calif.
FINAL DESIGN OF SODIUM-HEATED, MODULAR, STEAM GENERATORS FOR THE SCTI
D. F. Casey, J. J. Hammer, D. Logan, and M. C. Williams 1 Feb. 1965 101 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9826) OTS: $3.00

Design of a 37-tube, modular-type, low-temperature evaporator and high-temperature superheater for testing in the sodium component test installation was initiated. The evaporator and superheater modules, when combined, would be capable of generating 2400-psi, 1050° F steam. This report covers the final design of the modular steam generators. Author

N65-17032# Argonne National Lab., Ill. Reactor Engineering Div.
A STUDY OF THE INITIATION OF NUCLEATE BOILING IN THE LIQUID METALS
Robert E. Holtz Dec. 1964 24 p refs
(Contract W-31-109-ENG-38)
(ANL-6980) OTS: $2.00

An analysis was conducted to predict the liquid superheats required to initiate nucleate boiling in the alkali metals. The classical two-phase mechanical and thermal equilibrium equation is solved by applying a model of the behavior of the pressure in the liquid for water and the alkali metals. Curves are presented showing the liquid superheats required for nucleate boiling in sodium and potassium. Author

N65-17092# Atomics International, Canoga Park, Calif.
HIGH TEMPERATURE EXPERIMENTS ON FISSION PRODUCT RETENTION IN SODIUM
W. P. Kunkel, D. M. Elliott, and A. S. Gibson 1 Feb. 1965 63 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9287) OTS: $3.00

Experiments were performed to evaluate the extent of retention for fission products released into high temperature sodium. Both inpile and out of pile experiments were performed with sodium temperatures of 1000° F for inpile studies and ranging from 900° to 1400° F for out of pile studies. In the inpile studies, small discs of preirradiated uranium metal were melted and a portion of the fission product inventory was dispersed in molten sodium by a transient neutron burst. In the out of pile study, fission products were injected by recoil during the preirradiation and by diffusion during the heating. Data were obtained in both cases by sampling the helium cover gas space above the sodium interface and relating the fission product activity observed to that measured in the sodium and to the estimated inventory of the preirradiated fuel. Severe cases in which up to 70% of the iodine inventory is released to the sodium were tabulated. This compilation suggests that under these temperature conditions approximately 2×10^{-4} of the iodine trapped in sodium may be available for further release to the environment. Author

N65-17093# Pratt and Whitney Aircraft, Middletown, Conn.
THE SOLUBILITY OF HELIUM IN LITHIUM AND POTASSIUM
H. Slotnick, S. M. Kapelner, and R. E. Cleary 24 Feb. 1965 28 p refs
(Contract AT(30-1)-2789)
(PWAC-380) OTS: $2.00

The solubility of helium in lithium and potassium was determined at temperatures to 871° and 704° C, respectively, and pressures to 3 atmospheres. The solubility of helium in both alkali metals increases with temperature and pressure. In lithium, the solubility increased from 3.89×10^{-7} moles helium per liter lithium per atmosphere at 649° C to 5.63×10^{-7} moles per liter-atmosphere at 871° C. In potassium the solubility increased from 5.87×10^{-5} moles per liter-atmosphere at 482° C to 1.71×10^{-4} moles per liter-atmosphere at 704° C. Henry's law is obeyed in each case. Author

N65-17105# Atomics International, Canoga Park, Calif.
TEMPERATURE DISTRIBUTIONS IN THE SRE CORE-II FUEL ELEMENT
C. L. Peckinpaugh 1 Feb. 1965 23 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10153) OTS: $1.00

Measurements with an experimental bowable fuel cluster showed that unusually large steady-state temperature differences existed within the SRE Core-II fuel coolant channel. Large temperature differences were measured across the rod bundle, between the inside and outside coolant regions, and across the annular outside flow area. The maximum radial ΔT observed was 200° F. The temperature difference across the rod bundle was caused by misalignment (thermal bowing) of the fuel rod cluster within the coolant channel. The ΔT between the inside and outside coolant regions was due to an unbalance of power generation and flow rate. The ΔT across the outside coolant region occurred because of higher velocity sodium bypassing the rod bundle in the large annular clearance between the bundle and the coolant channel wall. Comparison of calculated temperature differences with measured results indicated that insufficient radial coolant mixing within the rod cluster was caused by excessive bypass coolant flow around the spiral wire wraps. Author

N65-17106# Atomics International, Canoga Park, Calif.
DRILLING GRAPHITE SAMPLES FROM IRRADIATED SRE MODERATOR ELEMENTS
R. D. Phelps 1 Feb. 1965 41 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10721) OTS: $2.00

A technique was developed to obtain samples of graphite from irradiated SRE moderator elements. Following removal of a small circular piece of cladding material from the surface of the element, a coring drill is used to cut a cylindrical graphite sample, 1 to 2 in. in diameter, extending from the surface of the graphite to the central coolant tube. The resulting graphite core is removed from the drill and stored under an inert atmosphere in a sealed container. Radiation levels associated with the graphite extracted from the element are less than one mr/hr per cubic inch after more than 6000 Mwd of exposure. The moderator element from which these samples are taken is also measured across the flats at 1-ft intervals over its entire length. The results are accurate to ±20 mils, which is less than the design tolerances specified at time of fabrication. Author

N65-17109# Atomics International, Canoga Park, Calif.
IRRADIATION SWELLING, PHASE REVERSION, AND INTERGRANULAR CRACKING OF U-10 wt% Mo FUEL ALLOY
R. M. Willard and A. R. Schmitt 1 Feb. 1965 31 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8956) OTS: $0.75

A fuel development program was conducted to investigate the behavior of U-10 wt% Mo alloy, at the fission rates and temperatures anticipated in Core I of the Hallam Nuclear Power Facility. Unrestrained samples, 0.5 in. in diameter by 2.0 in. long, were irradiated in the materials testing reactor for periods up to 3 years, to achieve substantial burnup levels at the relatively low Core I burnup rates. The specimens were irradiated in the fission rate range from 2.5 to 8.0×10^{12} fissions/cc-sec, at average central temperatures from 750° to 1085° F. Initially, the fuel specimen structures were as cast (inhomogeneous γ), partially transformed ($\alpha + \gamma' + \gamma$), or homogenized ($\gamma$). An almost linear relationship between swelling and burnup was obtained in the burnup range from 3000 to 12 000 Mwd/MTU. Eleven specimens from four irradiation capsules were examined metallographically, and exhibited some degree of phase transformation when compared to preirradiation structures. Author

N65-17110# Atomics International, Canoga Park, Calif.
ANALYSIS OF SNAPTRAN-3 DESTRUCTIVE EXPERIMENT
K. E. Buttrey, L. I. Moss, D. F. Paddleford, A. Weitzberg, and J. O. Zane 1 Feb. 1965 84 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9780) OTS: $3.00

Data obtained from the experiment are presented, and analysis of the data is discussed from the standpoint of determining the nuclear energy release and reactivity feedback effects. The results are compared with those obtained by theoretical means. Devices called energy probes were employed as a new technique for measuring the detailed history of the energy density in the fuel moderator. Using these devices to calibrate the nuclear power detectors, the total yield for the transient was 1.22×10^{18} fissions. Author

N65-17129# Argonne National Lab., Ill. Metallurgy Div.
CALORIMETRIC METHODS FOR THE ASSAY OF FUEL PINS AND RESIDUES
N. M. Lazar, S. Rosen, and A. B. Shuck Nov. 1964 36 p refs
(Contract W-31-109-ENG-38)
(ANL-6771) OTS: $2.00

The possibilities of using calorimetric methods for assay purposes were examined. Prototypes of twin-differential and rate calorimeters were assembled and experimentally investigated. These investigations indicate that calorimetric assay methods will be useful for these purposes. Based on results with the prototypes, more advanced calorimeters were constructed and are also described. Author

N65-17136# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SNAPTRAN 2/10A-3 DESTRUCTIVE TEST RESULTS
W. E. Kessler, O. L. Cordes, G. A. Dinneen, R. D. Fletcher, and G. F. Brockett Jan. 1965 138 p refs
(Contract AT(10-1)-205)
(IDO-17019) OTS: $4.00

A SNAP 10A/2 reactor core was subjected to rapid water immersion such as might result from an aborted space mission. The radiological results of the test dealt with the release and migration of radioactive fission products. Direct radiation from the burst and the decay during a 1-hour period yielded a direct dose of only 150 rem 8 feet above the reactor. The halogens were retained in the water. The radioactive cloud consisted primarily of noble gases and their daughters, with less than 5% of noble gas present in the core being released. No airborne beryllium contamination was revealed. Those aspects of reactor behavior which influenced the radiological results were related to the energy release, and to the mechanical mode of disassembly during the destructive excursion. The most probable value of the energy release was 45 ±4 Mw-seconds. The temperature dependent reactivity feedback was −0.19 ¢/° F. The maximum core temperature threshold for the onset of reactor disassembly was about 1900° F. Upon reaching this threshold the reactor disassembled at a slower rate than predicted. R.L.K.

N65-17152 United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE EMISSION OF XENON-133 FROM URANIUM
P. Biddle Sep. 1964 12 p refs
(AERE-R-4700) HMSO: 1s 9d

The emission of ^{133}Xe from a range of uranium carbonitride powders after short irradiations was studied by the postirradiation heating technique. Results show that the release from carbonitrides is comparable to that from uranium monocarbide. Author

N65-17197# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING NOVEMBER 1964
Russell W. Dayton and Stan J. Paprocki 1 Dec. 1964 43 p refs
(Contract W-7405-ENG-92)
(BMI-1704) OTS: $1.00

Projects on reactor materials and components, reactor fuels, radioisotope and radiation applications, coated-particle fuel materials, and corrosion in the fluoride-volatility process, as well as on the gas-cooled reactor program are reported. Individual papers cover such subjects as one type of stainless steel, chromium–rhenium alloys, graphite densification, solid-state pressure bonding, explosive sizing, organometallic compound formation, fuel particles, carbon coating, irradiation in a pile, encapsulation, and alloy cladding. D.E.W.

N65-17270*# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 SEALS-TO-SPACE DEVELOPMENT TEST PROGRAM. VOLUME I: VISCO PUMP
R. L. Lessley May 1964 118 p refs *Its* Rept.-2808, Vol. I
(Contract NAS5-417)
(NASA-CR-54234) OTS: HC $4.00/MF $0.75

A seal concept was evolved in which mixing of mercury and oil is prevented by venting a section of the shaft to space and permitting a small controlled leakage of each liquid to the space vent cavity. The particular seal-to-space concept advocated for use in SNAP-8 involves use of the visco pump (a device consisting of a shaft with helical grooves rotating within a close-fitting housing). Since the visco pump technology is not sufficiently advanced to permit prediction of conditions under which breakdown will occur, a test program was required to demonstrate the adequacy and operating conditions of the visco pump. Tests were conducted with quartz visco pump test sections which permitted viewing and photographing of the liquid–vapor interface during operation of the test rig. Results showed the visco pump interface to be stable for SNAP-8 operating conditions. In addition, measurements of drag and pumping coefficients were made for a variety of pump configurations. Author

N65-17271*# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 SEALS-TO-SPACE DEVELOPMENT TEST PROGRAM. VOLUME II: MOLECULAR PUMP
J. N. Hodgson May 1964 112 p refs *Its* Rept.-2808, Vol. II
(Contract NAS5-417)
(NASA-CR-54234) OTS: HC $4.00/MF $0.75

Flow restriction of mercury and lubricant vapor out of the vent into space is accomplished by the use of a molecular pump. The derivation of the theoretical performance of the pump was based upon the assumption of purely molecular flow, and a computer program was conducted for optimization of the pump dimensions over a large variety of operating conditions. However, SNAP-8 operating conditions do not place the flow at the high-pressure end of the molecular pump in the molecular flow regime; the flow extends well into the continuum regime. Thus, the predicted optimum configurations were not truly optimum. To rectify this, a theory was developed to define the performance over the entire spectrum of flow regimes, but the complexity of the final form of the equations precluded an optimization program. The first few configurations chosen for the test program were optimum as predicted by the molecular flow theory, and remedial measures were taken to increase the ratio of mean-free-path to channel dimensions. These procedures served to make the flow more closely approach the molecular regime. Tests were conducted on both optimum and nonoptimum configurations at temperatures of 300° and 375° F; the correlation between theory and test data was good. D.S.G.

N65-17272*# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 SEALS-TO-SPACE DEVELOPMENT TEST PROGRAM. VOLUME III: DYNAMIC SLINGER
R. L. Lessley and I. L. Marburger May 1964 73 p refs *Its* Rept.-2808, Vol. III
(Contract NAS5-417)
(NASA-CR-54234) OTS: HC $3.00/MF $0.75

The seal-to-space concept advocated for use in the SNAP-8 power conversion system rotating assemblies utilizes two basic elements. The first element creates a liquid-vapor interface (i.e., a line of demarcation between liquid and vapor). The second element restricts leakage of the vapors that emanate from the liquid–vapor interface. A dynamic slinger was selected as the liquid–vapor interface element for the current SNAP-8 seal-to-space configuration. For the slinger to fulfill its intended role, however, the liquid–vapor interface must be stable. Otherwise droplets, that can possibly pass on through the seal, may be generated by the interface. A series of tests were conducted in which oil and mercury slingers were operated at the specific conditions encountered in the SNAP-8 rotating assemblies. The purpose of these tests was to demonstrate that the slinger interfaces actually do provide a positive demarcation between liquid and vapor and thus create a barrier to prevent leakage of raw liquid. Pumping and drag data were also collected. The oil slinger tests revealed the presence on the slinger static wall of a film that could serve as a vehicle for the transport of oil past the interface. It was found that this problem could be avoided by coating the slinger walls with a nonwettable material such as Teflon. Tests of mercury slingers revealed a small population of liquid droplets within the interface radius. Author

N65-17273*# Aerojet-General Corp., Azusa, Calif. SNAP-8 Div.
SNAP-8 SEALS-TO-SPACE DEVELOPMENT TEST PROGRAM. VOLUME IV: INTEGRATED SEAL SIMULATOR
R. L. Lessley, J. N. Hodgson, and E. A. Haglund May 1964 45 p refs *Its* Rept.-2808, Vol. IV
(Contract NAS5-417)
(NASA-CR-54234) OTS: HC $2.00/MF $0.50

A seal-to-space has been developed to permit use of oil-lubricated bearings in the SNAP-8 mercury-vapor turbine assembly. Small leakages of oil and mercury to a space vent cavity are permitted (1 to 10 lb per year) in order to avoid intermixing of the two fluids. Since improper functioning of the seal would result in a complete loss of mercury and lubricating oil inventory, the development of the seal-to-space included individual tests of each seal element and culminated with the test of a complete seal operating in the thermal environment of the SNAP-8 turbine seal. The test revealed satisfactory results for both seal configurations. The Model A Seal Simulator leakage rates at SNAP-8 operating conditions were 3 lb of oil and 15 lb of mercury for each 10000 hours of operation. For the Model B, leakage rates were 12 lb of oil and 1 lb of mercury for each 10000 hours of operation. Author

N65-17294# Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM Semiannual Progress Report, Period Ending 30 Sep. 1964
W. O. Harms et al Feb. 1965 refs
(Contract W-7405-ENG-26)
(ORNL-3731) OTS: $7.00

The following topics are discussed: *Fueled-Graphite Development; Investigations of Fission-Product Behavior; Studies for AVR-German Pebble-Bed Reactor; Investigations of Moderator Materials; Studies of Advanced Systems and of Facilities and Equipment; Performance Analysis; Component Development and Testing;* and *Irradiation Testing of Components and Materials.* G.G.

N65-17307# Atomic Energy Commission, Idaho Falls, Idaho. Nuclear Technology Div.
ORGANIC COOLANT Summary Report
R. F. Makens, ed. Dec. 1964 480 p refs
(IDO-11401) OTS: $7.80

CONTENTS:

1. THE ORGANIC REACTOR CONCEPT Charles A. Trilling (Atomics Intern.) p 1–19 refs
2. PROPERTIES OF UNIRRADIATED COOLANTS William C. Taylor (Combustion Engineering, Inc.) p 9–38 refs
3. RADIOLYTIC AND PYROLYTIC STABILITY K. Lynn Hall (Calif. Res. Corp.) p 39–74 refs
4. PHYSICAL AND CHEMICAL PROPERTIES OF IRRADIATED COOLANTS Herman Mandel, Mary A. Rotheram, and Robert T. Keen (Atomics Intern.) p 75–174 refs
5. COOLANT RECLAMATION John C. Hillyer (Phillips Petroleum Co.) p 175–226 refs
6. IMPROVED ORGANIC COOLANTS John C. Hillyer p 227–260 refs
7. FILM FORMATION ON HEAT TRANSFER SURFACES Ralph J. Sullivan and Robert T. Keen (Atomics Intern.) p 261–354 refs
8. DOSIMETRY M. A. Sweeney (Calif. Res. Corp.) p 355–378 refs
9. REFERENCE COMPOUNDS W. M. Hutchinson and R. C. Doss p 379–394 refs
10. ANALYTICAL METHODS FOR ORGANIC REACTOR COOLANT Robert C. Shepard and Robert T. Keen (Atomics Intern.) p 395–465 refs

N65-17361# Brookhaven National Lab., Upton, N. Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 2, NO. 6 Bimonthly Progress Review
O. E. Dwyer, ed. Dec. 1964 38 p refs
(BNL-906(PR-12)) OTS: $2.00

Abstracts included concern the following areas of high-temperature liquid-metal technology: physical properties and thermodynamics, fluid dynamics, heat transfer, material development and corrosion, instrumentation, component development, system studies, chemistry, and fabrication techniques. Three tables show the extent of research and development in this country in the three fields of physical property measurement, heat transfer technology, and corrosion studies. R.L.K.

N65-17362# Atomics International, Canoga Park, Calif.
THE NAA 47 U-10 Mo FUEL IRRADIATION PROGRAM FOR HNPF CORE I
A. R. Schmitt, R. M. Willard, and D. K. Magnus 1 Feb. 1965 66 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8955) OTS: $1.50

A fuel irradiation program was conducted to investigate and define the behavior of U–10 Mo fuel at the temperatures and fission rates anticipated in Hallam Nuclear Power Facility (HNPF) Core I. Each of the eight irradiation tests contained nine cast fuel specimens, NaK bonded in a double-walled stainless steel capsule. The experiments were irradiated in the Materials Testing Reactor for periods up to 3 years, to achieve substantial burnup levels at the relatively low Core I burnup

rates, and then were disassembled and examined. Only the low-burnup specimens and the top specimens in certain other capsules were relatively stable. Most of the higher-burnup fuel specimens swelled excessively, low inpile strength and radiation-induced plasticity were indicated, and some axial surface cracking was observed. The NaK bond had extensively permeated the highly swelled fuel. Postirradiation metallographic studies to investigate the phase stability of U–10 Mo are also reported. As a result of the studies, the peak allowable burnup for HNPF Core I was substantially reduced from earlier estimates, to ~4000 Mwd/MTU. D.S.G.

N65-17375# Battelle Memorial Inst., Columbus, Ohio.
PREPARATION AND EVALUATION OF ALUMINA-COATED FUEL PARTICLES
Melvin F. Browning, Virginia M. Secrest, and John M. Blocher, Jr. 20 Jan. 1965 75 p refs
(Contract W-7405-ENG-92)
(BMI-1708) OTS: $1.75

Dense high-purity alumina coatings were applied to UO_2 particles in a fluidized bed by the hydrolysis of $AlCl_3$ vapor. These coatings were sufficiently impervious to show excellent fission-gas retention upon heating to 1300° C after a low neutron exposure. Alumina-coated UO_2 fuel particles withstood 10 a/o burnup at 900° C with essentially no release of Xe^{133}. The most satisfactory coatings were deposited at about 1000° C and appeared to have a structure consisting of submicron grains of alpha-alumina in an amorphous matrix. Alumina deposited at 1300° C was less desirable because of its large-grained anisotropic structure, which was inherently weaker and more susceptible to thermal stress. Porous coatings were obtained at deposition temperatures of 500° to 900° C. At deposition temperatures of 1000° to 1400° C the alumina was equivalent to synthetic sapphire in hardness and density. The properties of dense alumina coatings were not grossly affected by varying the deposition rate between 1.5μ and 10μ per hr or the stoichiometric excess of oxidizing agent between 20% and 70%.
Author

N65-17376# Martin Co., Baltimore, Md. Nuclear Div.
THERMIONIC DOUBLE-DIODE PROGRAM Quarterly Technical Progress Report, Jun. 16–Sep. 15, 1964
E. A. Scicchitano and W. J. Levedahl 30 Sep. 1964 37 p ref
(Contract AF 33(615)-1289)
(MND-3149-2; AD-606476)

In a program to fabricate and assemble two double-diode modules of improved design that contain essential features of multiple-diode uranium dioxide fueled thermionic fuel elements but which utilize electron bombardment heating, fabrication of all components, and test fixtures was completed. One module was assembled. Gammagraphs of the module showed an excellent internal configuration, and the initial electrical checkout showed good electrical resistance throughout the module. Fabrication and pretest examination of sample fueled emitters for thermal endurance and vacuum emission tests were completed. R.L.K.

N65-17402# Atomics International, Canoga Park, Calif.
RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORTHO TERPHENYL AT HIGH TEMPERATURE
J. M. Scarborough [1964] 30 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8277) OTS: $0.50

The pyrolytic decomposition rates of orthoterphenyl were determined at various temperatures between 750° and 900° F and the temperature dependence of the initial rates was established. The formation rates for biphenyl in the pyrolysis of orthoterphenyl were also determined. The radiolytic decomposition of orthoterphenyl was studied in the same temperature range using 1.0 MeV electrons from a Van de Graaff generator. The temperature dependence of initial radiolytic decomposition rates was established. Comparisons were made between the pyrolytic and radiolytic behavior of orthoterphenyl. Author

N65-17416# Atomics International, Canoga Park, Calif.
MULTIGROUP CALCULATION METHODS WITH APPLICATION TO THE SGR CRITICAL EXPERIMENT
F. L. Fillmore 1 Feb. 1965 68 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10531) OTS: $3.00

The adequacy of methods for treating certain features of multigroup calculations in graphite moderated lattices is examined. The features of most concern are thermal neutron spectrum effects arising from the separation of fuel and moderator; resonance capture and fission; and fast fission. One of the most significant deficiencies in methods which employ a homogeneous model in treating nonthermal groups is a large error in the treatment of fast fission. The defect in reactivity is about 4% for the lattices considered here. This can be partially corrected by means of a diffusion theory cell calculation, but transport theory is needed in order to obtain good results. It was found that some of the homogenizing methods examined introduced, in some cases, errors of more than 2% in calculated reactivities. This error is of opposite sign to that of fast fission. Shortcomings in the treatment of resonance capture and fission were not found to contribute large errors in the lattices studied. This is reasonable because all of these lattices are well thermalized. Reactivity values obtained with a flux-weighted multigroup procedure are in good agreement with measurements. Author

N65-17418# Bettis Atomic Power Lab., Pittsburgh, Pa.
RADIATION DAMAGE EXPOSURE AND EMBRITTLEMENT OF REACTOR PRESSURE VESSELS
K. Shure Nov. 1964 68 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-471) OTS: $3.00

The procedure used to obtain estimates of the changes in the ductile-to-brittle transition temperature of ferritic steel due to neutron irradiation was examined. These estimates are shown to depend on the neutron spectrum employed in the interpretation of the activation of the fast neutron monitor associated with radiation damage specimens and on the damage cross section model used in evaluating irradiation exposures. A damage model which accounts for neutron spectral differences between irradiation locations was used to obtain a physically more meaningful measure of exposure than the usually cited neutron flux above 1 MeV (nvt > 1 MeV). Available data on the change in transition temperature for A302B pressure vessel steel were correlated with this newer exposure parameter. A physically reasonable estimate of the functional dependence of this correlation was fit in a least squares sense to these data, and one-sided tolerance limits were ascribed for use by reactor designers. Author

N65-17420# Los Alamos Scientific Lab., N. Mex.
TRANSIENT TEMPERATURE ANALYSIS OF THE FUEL LOADER PUSH ROD AND GUIDE TUBE IN THE ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX)
C. H. Treat 22 Jan. 1965 26 p refs
(Contract W-7405-ENG-36)
(LA-3174-MS) OTS: $2.00

During the fuel loading procedure in the Ultra High Temperature Reactor Experiment (UHTREX) the fuel loader guide tube is subjected to a high thermal radiation flux. This report examines various means by which the resultant heating of the guide tube may be minimized. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-16351# Joint Publications Research Service, Washington, D.C.

IZVESTIYA VUZov: RADIOPHYSICS, VOLUME VII, NO. 4, 1964

14 Jan. 1965 299 p refs Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavadenii, Radiofiz. (Gor'kiy) v. 7, no. 4, Jul.–Aug. 1964 p 585–805
(JPRS-28302; TT-65-30131) OTS: $6.00

Radiophysics journal articles on radio telescope design, electromagnetic propagation in plasmas, Cerenkov radiation, electromagnetic scattering, magnetoactive plasmas, geometrical optics, directional properties of antennas, klystron operation, and circuit theory. For individual titles see N65-16352–N65-16373.

N65-16363 Joint Publications Research Service, Washington, D.C.

TWO-DIMENSIONAL SOLUTION OF THE WAVE EQUATION FOR A LAYER WITH NEGATIVE COEFFICIENT OF ABSORPTION AND CONSIDERING SATURATION

T. I. Kuznetsova and S. G. Rautian *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 127–140 refs (See N65-16351 07-23) OTS: $6.00

A monochromatic field which is established inside a layer of an active medium is calculated. The layer is bounded by plane parallel mirrors having arbitrary coefficients of reflection. The frequencies of the field and the fluxes emitted through the boundaries of the layer are determined. The results are compared with theoretical conclusions based on transfer equation. Author

N65-16364 Joint Publications Research Service, Washington, D. C.

ON QUANTIZATION IN INVESTIGATING THE NONSTATIONARY LAWS OF PHASE DISTRIBUTION

S. A. Akhmanov, V. P. Komolov, and A. S. Chirkin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 141–152 refs (See N65-16351 07-23) OTS: $6.00

A single-circuit parametric generator is used as the phase quantizer. The processing of quantized samples is done by the spectrum method, and by the series method. It is shown that when $(S/N)_{in} < 1$, then information about the signal amplitude can be obtained at the quantizer input, while information about the phase (or frequency) of the quantized signal can be obtained when $(S/N)_{in} > 1$ to 2. Author

N65-16365 Joint Publications Research Service, Washington, D. C.

ON THE SPECTRUM OF A QUASI-HARMONIC SIGNAL AT SUFFICIENTLY GENERAL ASSUMPTIONS AS TO LAW ACCORDING TO WHICH THE FREQUENCY FLUCTUATIONS ARE DISTRIBUTED

A. M. Gersht *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 153–161 refs (See N65-16351 07-23) OTS: $6.00

The spectrum of a quasi-harmonic signal is examined on the basis of the analogy between the normalized spectrum of the signal and the probability density. Broad assumptions are made as to the law according to which the frequency fluctuations are distributed. Author

N65-16366 Joint Publications Research Service, Washington, D.C.

SOLUTION OF NONLINEAR EQUATIONS FOR FLUCTUATIONS IN AMPLITUDE AND PHASE OF A SELF-EXCITED OSCILLATOR

A. N. Malakhov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 162–177 refs (See N65-16351 07-23) OTS: $6.00

Nonlinear equations of the amplitude and phase fluctuations of an auto-oscillator being under the action of noise with arbitrary bandwidth, are solved. Author

N65-16367 Joint Publications Research Service, Washington, D.C.

RADIATION OF A SMALL GYROTROPIC SPHERE

A. V. Vashkovskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 178–188 refs (See N65-16351 07-23) OTS: $6.00

The problem of the parametric oscillation in a small gyrotropic sphere is solved by the method of successive approximations in the nonlinear approximation. The radiation power of a gyrotropic ferrite sphere is computed, and its dependence on ferrite parameters is found. Author

N65-16369 Joint Publications Research Service, Washington, D. C.

ON THE NONLINEAR THEORY OF CHARGE DENSITY WAVES IN BEAMS WITH VARIABLE PARAMETERS

V. D. Shapiro *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 198–212 refs (See N65-16351 07-23) OTS: $6.00

Considered is a nonlinear theory of the parametric excitation of charged density waves in a density modulated beam and a velocity modulated beam. The consideration is limited to the simplest case of an infinitely wide beam that is homogeneous in cross section and has a small modulation index. It is demonstrated that in a nonlinear regime the amplitude and phase of the oscillations become periodic functions of the coordinates; the maximum and minimum values of the amplitude and the period of its variation are found. Author

N65-16470# North Carolina Univ., Chapel Hill. Inst. of Field Physics

[INVARIANCE PRINCIPLES, SCALER FIELD INTERACTIONS WITH THE GRAVITATIONAL FIELD, MACHINE COMPUTATION OF EINSTEIN EQUATION, AND QUANTUM THEORY OF MICROSCOPIC BODIES] Status Report, 1 Dec. 1963–30 Nov. 1964

Bryce S. De Witt [1964] 12 p refs
(Contract Nonr-855(07); Grant AF-AFOSR-153-63)
(AD-608117)

Technical accomplishments in the following areas were summarized: (1) formulation of invariance principles directly in terms of experimental observations and independently of the framework of any particular theory; (2) cross-section calculations for the lowest order processes involving the interactions of a scalar field with the gravitational field, and with the first-order renormalization of the action used to find these cross sections; (3) machine computation of modified Einstein equation; and (4) solution of the problem of reduction of the wave packet in quantum mechanics based on the absolute uncertainty of space time structure due to the combination of the Heisenberg uncertainty relations with the phenomenon of gravitation. E.E.B.

N65-16474*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Letter Report, Jan. 1–Mar. 1, 1964
Gene A. Zerlaut 13 Mar. 1964 6 p
(Contract NASr-65(07))
(NASA-CR-53523; IITRI-C6018-7)

Particle radii were determined from the observed wavelengths of the transmittance minima and maxima related to the total Mie scattering coefficient. Radii values obtained from light scattering measurements agreed with those obtained from electron micrographs. The concentration of scattering centers determined from light-scattering measurements gave good agreement up to a particle size of 1.2 diameters, when compared with the values calculated from the weight of silver bromide in suspension. Multiple scattering effects were observed in highly concentrated suspensions in gelatin. Dilute suspensions containing an equal number of scatterers gave equal transmittances, and were independent of the size of the particles as predicted by the Mie theory. Dilute suspensions containing particles of two different sizes showed no interactions. E.E.B.

N65-16563# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A MEASUREMENT OF THE EFFECT OF ATMOSPHERIC TURBULENCE ON THE COHERENT PROPERTIES OF A SOUND WAVE
John W. Coffman Jan. 1965 36 p refs
(ERDA-254; AD-455554)

Described is an experiment to measure with an acoustic diffraction grating the fluctuations of a sound wave due to atmospheric turbulence. The grating corresponds to a band-pass filter with a bandwidth of 10^{-2} cm^{-1} in wave number. The measurement is related to the scattering of electromagnetic energy by periodic sound waves, an effect upon which the EMAC probe depends. Measurements were made at an acoustic wavelength of 3.48 cm. Under the conditions of the tests, turbulence was found to have no effect on the sound wave. Author

N65-16567# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
BROWNIAN MOTION MODEL OF NONRELATIVISTIC QUANTUM MECHANICS
G. G. Comisar 30 Jan. 1965 28 p refs
(Contract AF 04(695)-469)
(TDR-469(5220-20)-2; SSD-TDR-64-268; AD-455908)

In Feynman's space–time approach to nonrelativistic quantum mechanics, the wave function may be considered to be the sum of path integrals over Brownian motion trajectories. A hidden variable corresponding to particle velocity may be introduced in order to represent the wave function as a sum of path integrals taken over phase space trajectories. By means of a hidden parameter corresponding to the time scale of fictitious interactions of the particle with the vacuum, generalized propagators can be defined which over very short times produce wave functions that are localizable in phase space, and hence are deterministic. For long times the conventional Feynman formalism is recovered. The present Brownian model is linear and preserves the usual statistical interpretation of the wave function for sufficiently long times. Author

N65-16724# North Carolina State Coll., Raleigh. Dept. of Engineering Mechanics
THE M INTEGRAL OPERATOR: AN APPLICATION OF THE CAUCHY–HOBSON THEORY TO THE SEMI-INFINITE MEDIUM
P. H. Mc Donald and G. A. Myers Oct. 1964 26 p refs
(Contract DA-01-009-ORD-991)
(AD-608312)

A classical problem in the theory of elasticity is that of the semi-infinite elastic solid. The general theory is formulated with respect to a rectangular Cartesian coordinate system, the components of stress developed in cylindrical coordinates, and a general integral operator used to evaluate the result. Application of the integral operator to the contact stress problem, for the stresses in the case where an elastic sphere is pressed against an elastic half-space and twisted until complete slip occurs, is presented. E.E.B.

N65-16770# Union Coll., Schenectady, N. Y. Mechanical Engineering Dept.
SOME APPLICATIONS OF JOURNAL BEARING GREEN'S FUNCTIONS
Joseph Modrey Nov. 1964 62 p refs
(Contract Nonr(G)-00012-63)
(AD-608519)

The fundamental Green's Function for journal bearings, derived in a previous report, were applied to both externally pressurized bearings and self-acting bearings. The Green's Function solution agrees very well with the theoretical solution of a self-acting bearing with Sommerfeld conditions. Small discrepancies between the Green's Function solution and experimental hydrostatic bearing data exist at the higher eccentricities. Differences arise from errors in estimating orifice discharge coefficients, the neglect of local turbulent conditions in the Green's Function solution, and tolerances in the real clearances of experimental models. All three of these factors seem equally important in an error analysis; hence the accuracy of Green's Function solutions is compatible with the realities to be recognized in applying the theory of lubrication. Author

N65-16830*# Seton Hall Univ., South Orange, N. J.
THE EXPLICIT SOLUTION OF THE ANALYTIC N-BODY PROBLEM
L. M. Rauch [1963] 33 p refs
(Grant NsG-413)
(NASA-CR-53213) OTS: HC $2.00/MF $0.50

This paper resolves the n-body problem in explicit form. In essence the resolution consists of two phases, namely, to unfold the coefficients of the formal series, representing the

solution, as functions of the initial conditions, and to show the existential validity of this formalistic solution of the nonregularized [6,10] system of equations of motion. To develop these processes in the solution of the problem, general formulas are evolved connecting the parameters in the equations of motion; a set of complexes are associated in the solutions involving the parameters with the coefficients of the formal time series; the emerged recursive expressions of the coefficients are reduced to an irreducible recursive one; and the region in which the formal time series represents the solution of the nonregularized n-body problem are specified. Author

N65-16838*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Fourth Monthly Progress Report, 1 Oct.–1 Nov. 1963
Gene A. Zerlaut [1963] 11 p
(Contract NASr-65(07)
(NASA-CR-55196; IITRI-C6018-4) OTS: HC $1.00/MF $0.50

The current status of the program is as follows: (1) Several precipitation procedures were used to vary the particle size of the silver chloride suspensions while retaining uniformity. Uniformity of size was achieved but the desired control of size was not. (2) Four concentrations of silver chloride coatings were prepared—0.062 M, 0.123 M, 0.185 M, and 0.246 M. Dilutions were made with gelatin so that each coating contained an equal amount of gelatin. These dilutions were spread on quartz plates with a Gardner knife and were quickly dried in a hot-air stream to give coatings of uniform particle density and thickness. (3) Reflectance and transmittance spectra of silver chloride coatings were measured with the Cary spectrophotometer. The coatings showed a transmission peak at 2400 A and a minimum at about 2800 A. I.v.L.

N65-16852 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ULTRASOUND FOR INVESTIGATION OF DYE-STUFF CRYSTALLIZATION PROCESSES
K. N. Marenina and I. G. Mikhaylov *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 65–85 refs (See N65-16845 07-34)

The principal problems of the theory of ultrasound absorption in suspended particles are discussed. The experimental data proving the correctness of the principal theoretical statements are given. An attempt was made to apply the results obtained to the investigation of the crystallization processes of various substances. Author

N65-16853 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF INTENSITY AND HALF-WIDTH OF SPECTRAL LINES IN THE CASE OF THE BAND DESCRIBED BY THE ELSASSER MODEL
A. P. Gal'tsev *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 86–94 refs (See N65-16845 07-34)

A new method is given to define intensivity and halfwidth of spectral lines, i.e., spectral line with dispersion contour and Elsasser band. This method is suitable for any value absorbing gas W, β and does not depend on the form slit-width function. The approximation absorption function for any value β was received. Author

N65-16900# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics
THE METASTABILITY OF AMORPHOUS STRUCTURES
Morrel H. Cohen (Chicago Univ.) and David Turnbull 25 Sep. 1964 5 p refs
(Contract Nonr-1866(50))
(TR-1; AD-608760)

Two instances are given to support the correctness of the metastability hypothesis. (1) The discovery that a random arrangement of hard spheres will compress to a rigid and apparently amorphous structure (dense random structure) leads to the conclusion that the condition of mutual inaccessibility of equivalent structures is satisfied, and, hence, is metastable. (2) The recent machine calculations of Rahman further confirm the high resistance of amorphous systems to the initiation of crystallization, indicating metastability. E.E.B.

N65-16908# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
RESEARCH ACTIVITY Consolidated Quarterly Progress Report, 1 Jul.–30 Sep. 1964
G. A. Bekey et al [1964] 114 p refs
(Contracts AF 04(695)-537; AF 19(604)-6195; Grants AF-AFOSR-75-63; AF-AFOSR-76-63; AF-AFOSR-188-64)
(Rept.-1; AD-608490)

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N65-16946# Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
SHOCK-INDUCED POLARIZATION OF PLEXIGLAS AND POLYSTYRENE
F. E. Allison and G. E. Hauver Aug. 1964 30 p refs
(BRL-1258; AD-451774)

The theory describing the electric polarization produced in certain dielectrics by the passage of a shock front has been generalized to take account of relaxation effects. The shock-induced displacement current is described in terms of three parameters: P_s^o, the polarization produced at the shock front; K', the dielectric constant of the shocked materials; and τ, a relaxation time. Values of P_s^o, K', and τ have been obtained experimentally for Plexiglas and polystyrene at a number of different pressures. At the pressures where Hugoniot data indicate phase transitions, P_s^o and K' increase rapidly with pressure. In the same pressure range, the relaxation time decreases by nearly two orders of magnitude, indicating that molecular motion occurs more freely in the high-pressure phase. Greater freedom of molecular motion would enable the materials to be

more easily polarized by both mechanical and electrical forces in agreement with the observed increase in both P_s^o and K' at the phase transition. Author

N65-16968# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
THE EFFECT OF THE SOLID ANGLE OF ILLUMINATION OR OBSERVATION ON THE COLOR SPECTRA OF "WHITE LIGHT" SCATTERED BY CYLINDERS
William A. Farone Jan. 1965 95 p refs
(ERDA-249; AD-456796)

Calculations are made for two sources of white light: (1) the noonday sun (The International Commission on Illumination standard source B), and (2) a tungsten lamp corresponding to a 3200° K blackbody. The angular pattern of the dominant wavelength and excitation purity, under the International Commission on Illumination tristimulus coordinate system, are calculated for cylinders of radii $0.5\mu(0.5\mu)2.0\mu$ and of refractive index equal to 1.46. Author

N65-16976*# Stanford Research Inst., Menlo Park, Calif.
MAGNETIC PROPERTIES OF SOME MACROMOLECULES OF BIOLOGICAL INTEREST Progress Report No. 1, 1 Aug.–1 Nov. 1963
14 Nov. 1963 5 p refs
(Contract NASr-49(16))
(NASA-CR-52854) OTS: HC $1.00/MF $0.50

The principal component of an apparatus to measure magnetic susceptibility is a modulated inductance detector. The persistent current in the superconducting circuit is a permanent record of any flux change caused by the removal of a magnetized sample. The flux change is proportional to the magnetization of the sample and to its magnetic susceptibility. Three types of compounds were selected for initial susceptibility measurements. All three contain large conjugated rings, and may be capable of giving rise to interesting effects in high magnetic fields. The first is a group of synthesized anulenes; these are large single-ring hydrocarbons containing as many as 30 carbon atoms. The second is a group of condensed-ring molecules: coronene, $C_{24}H_{12}$; ovalene, $C_{32}H_{14}$; and circumanthracene, $C_{40}H_{16}$. The third is a group of porphyrins and phthalocyanines. R.L.K.

N65-16978*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Fifth Monthly Progress Report, 1 Nov.–1 Dec. 1963
Gene A. Zerlaut [1963] 11 p
(Contract NASr-65(07))
(NASA-CR-55282; IITRI-C6018-5) OTS: HC $1.00/MF $0.50

Activities are reported in the following areas: (1) crystal growth—size control over the AgCl crystals grown by the simultaneous additions of stoichiometric quantities of $AgNO_3$ and KCl, and (2) angular scattering of light by silver chloride films—the determination of the angular distribution of scattered light by a monodispersed AgCl film. R.T.K.

N65-16988*# California Univ., Berkeley. Space Sciences Lab.
THE THREE BODY PROBLEM
C. G. Lemaitre 20 Aug. 1963 48 p refs *Its* Ser.-4, Issue 49
(Grants NsG-243-62; NsG-122-61)
(NASA-CR-51986) OTS: HC $2.00/MF $0.50

In order to obtain the equations of the Three Body Problem in the Hamiltonian form, relative axes are introduced which are the principal axes of inertia of the system of the three masses. The Cartesian coordinates of the masses relative to the principal axes are defined by way of three coordinates r, B, L, which are related in a simple way to the three distances r_1, r_2, r_3 of the masses. These formulae involve three angles, μ_1, μ_2, and μ_3, depending on the masses. They are the angles of the triangle of the masses in the particle configuration for which the ellipse of inertia is a circle. The elimination of the modes is made in the usual way by elimination of the Eulerian angle Θ, and the Hamiltonian is obtained. The relation of the coordinates used in this proposal with a variable introduced by Lagrange in 1772 is shown, leading to simplification in the work of Lagrange; the result of Lagrange on the equilateral configuration is deduced from this Hamiltonian. C.L.W.

N65-17019# Wisconsin Univ., Madison. Mathematics Research Center
A GENERALIZED STOCHASTIC MODEL FOR QUANTUM MECHANICS
Stanley P. Gudder Jan. 1965 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-539; AD-610458)

An axiomatic model for quantum mechanics is formulated using the experimental propositions as undefined axiomatic elements. The quantum mechanical states and observables are then defined. The model is presented by means of the following postulates: (1) The experimental propositions of a quantum mechanical system form a full orthocomplemented partially ordered set. (2) A quantum mechanical observable is an observable. (3) The probability that an observable x has a value in a set E when the system is in a state m is m[x(E)]. (4) If the system has a finite number of degrees of freedom, then the coordinate observables are absolutely continuous with respect to Lebesgue measure, and the momentum observables are the Fourier transform of the conjugate coordinate observables. Author

N65-17036# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
N-PARTICLE KINEMATICS AND GROUP-THEORETICAL TREATMENT OF PHASE-SPACE. PART I: NONRELATIVISTIC
Jean-Marc Lévy-Leblond and Francois Lurcat Jan. 1965 19 p refs
(TH-80)

A systematic method for constructing a new complete set of commuting observables is given. This method is based on the existence of a group (the great group) which acts transitively on the phase-space manifold, and preserves the phase-space volume element. The observables are then Casimir operators of the great group and of some its subgroups, including the usual three-dimensional rotation group. Among these collective observables, in addition to the total angular momentum, the most interesting is the "togetherness operator," which describes the simultaneous localization of the N particles. This operator is a generalization to $N > 2$ of the square of orbital angular momentum; its use allows to generalize to N particles the familiar centrifugal barrier arguments. Author

N65-17040# Naval Ordnance Lab., White Oak, Md.
TABLES OF THE DAVIDSON–COLE AND THE LOG GAUSSIAN DISTRIBUTION FUNCTIONS OF RELAXATION TIMES
James J. Lichter and George E. Mc Duffie Dec. 1964 92 p refs
(NOLTR-64-170; AD-608562)

Several fields of experimental physics employ distribution functions of relaxation times to describe the processes of energy transfer. It is convenient to have tables of the values of these functions for different values of their parameters. This paper presents such tables of the asymmetric Davidson–Cole distribution and the symmetric log Gaussian distribution for various widths of the distributions. Author

N65-17103# Rochester Univ., N. Y. · Dept. of Physics and Astronomy

THE QUARK MODEL AS A PROBE OF HIGHER SYMMETRIES

S. Okubo and R. E. Marshak 14 Jan. 1965 26 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-72)

In order to relate hadron multiplets with different spins and/or parities, it is necessary to mix the Lorentz groups with the internal symmetry groups by empirical correlations. In order to restrict the possible choices of a large mixed group, a model based on a triplet of four-component spinor fields that interact via a four-fermion interaction is considered. The progress in utilizing the quark model as a probe to determine the nature of a possible larger mixed Lorentz–internal symmetry group, as well as the manner in which this group is broken, is presented. It was found that a quark model with Casimir decomposition is capable of producing a sufficiently large mixed group to incorporate spin and unitary spin. G.G.

N65-17104# Rochester Univ., N. Y. Dept. of Physics and Astronomy

A NOTE ON THE DECOMPOSITION STRUCTURE OF THE DIRECT PRODUCT OF IRREDUCIBLE REPRESENTATIONS OF SU(3) BY TENSOR METHOD

N. Mukunda and L. K. Pandit 4 Jan. 1965 20 p refs

(Contract AT(30-1)-875)

(UR-875-71)

Tensor methods are employed to determine which unitary irreducible representations (U.I.R.'s) (α,β) occur in the reduction of the direct product $(\lambda,\mu) \otimes (\lambda',\mu')$ of two arbitrary U.I.R.'s of SU(3). For λ',μ' large enough $(\lambda',\mu' \geq \lambda+\mu)$, it is shown that all the representations (α,β) are given by the following unique correspondence: for each pair of I_z,Y values (i.e., to each weight) occurring in the representation (λ,μ) there is a representation (α,β) with $\alpha=\lambda'+I_z+3/2Y, \beta=\mu'+I_z-3/2Y$, where the multiplicity of occurrence of (α,β) is the same as the multiplicity of the weight I_z,Y in the representation (λ,μ). Author

N65-17127*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FOUR-DIMENSIONAL DERIVATION OF THE ELECTRODYNAMIC JUMP CONDITIONS, TRACTIONS, AND POWER TRANSFER AT A MOVING BOUNDARY

Rovert C. Costen Washington, NASA, Feb. 1965 40 p refs (NASA-TN-D-2618) OTS: HC $2.00/MF $0.50

The derivation of the boundary conditions starts from Maxwell's equations in four-dimensional integral form; the boundary conditions are obtained directly in covariant form and are then translated to three-dimensional language. The inclusion of surface charge and surface current leads to a general current boundary condition containing a surface curvature term. Surface current is found to have a component normal to the surface due to the convection of surface charge in this direction. A surface form for the electromagnetic momentum and energy conservation laws is derived from the boundary conditions by using the same method by which the volumetric conservation laws are derived from Maxwell's equations. This surface form gives the electromagnetic tractions and energy transfer at the surface in two forms: (1) in terms of the jump in the stress-energy tensor; and (2) in terms of surface current, surface charge, and the mean field across the surface. A set of identities is obtained for the force density and power-transfer density associated with the antisymmetrical part of the stress-energy tensor. The merit of these identities rests largely on their value as evidence in the controversy over the symmetry of the stress-energy tensor. Author

N65-17162# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.

SOLUTION METHODS FOR MIXED BOUNDARY VALUE PROBLEMS

R. A. Westmann Wright-Patterson AFB, Ohio, ARL, Jan. 1965 60 p refs

(Contract AF 33(616)-7806)

(ARL-65-9; AD-610506)

Several methods for solving mixed boundary value problems in elasto-statics were surveyed, in order to call attention to a number of techniques available, and some of their essential features. Author

N65-17169# Wisconsin Univ., Madison. Mathematics Research Center

A NUMERICAL APPROACH TO BIHARMONIC PROBLEMS, PART I

Donald Greenspan Dec. 1964 16 p refs

(Contract DA-11-022-ORD-2059)

(MRC-523; AD-610447)

A new numerical method is described for biharmonic problems. The essence of the technique is to combine variational and difference methods in approximating a functional for which the biharmonic equation is a Euler equation. Typical problems and computer results are described. Author

N65-17333*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN ANALYTICAL COMPARISON OF SOME ELECTROMAGNETIC SYSTEMS FOR REMOVING MOMENTUM STORED BY A SATELLITE ATTITUDE CONTROL SYSTEM

Stuart C. Brown Washington, NASA, Mar. 1965 43 p refs (NASA-TN-D-2693) OTS: HC $2.00/MF $0.50

Summarized are the results of a study of methods of removing angular momentum stored in a satellite by producing an electromagnetic torque by coupling the vehicle with the earth's magnetic field. The coupling is achieved by inducing a magnetic moment by means of an electric current in coils on the vehicle. The conventional method of controlling the removal of momentum requires that the local magnetic field be measured with a magnetometer, and that a computation be performed on the measured field components to prescribe the current in each coil. An adaptive method, however, can also be used. In this method, instead of a magnetometer, an accurate determination of changes in stored angular momentum due to selected changes in magnetic moment is used. As a consequence of this approach, the adaptive momentum removal method is applicable only for vehicles in which a relatively high gain attitude control system is required. Author

N65-17342# Brown Univ., Providence, R. I. Div. of Applied Mathematics

ON DISSIPATION INEQUALITIES AND LINEAR VISCOELASTICITY

M. E. Gurtin and I. Herrera (Mexico Univ.) Jun. 1964 23 p refs
(Contract Nonr-562(25))
(TR-27; AD-603123)

The relaxation integral law of the linear viscoelasticity theory is studied in order to find the necessary restrictions that must be considered to satisfy certain thermodynamic requirements. The thermodynamic assumption is that an instantaneous elasticity tensor must be considered for the accelerated history and an equilibrium elasticity tensor for the retarded history to deform a viscoelastic solid from its original state. It was concluded that if the stress–strain law is dissipative, then both the instantaneous elasticity tensor and the equilibrium elasticity tensor are positive semidefinite and symmetric. G.G.

N65-17386# Brown Univ., Providence, R. I. Div. of Applied Mathematics

NON-LINEAR VISCOELASTIC SOLIDS

R. S. Rivlin Aug. 1964 47 p refs
(Contract Nonr-562(30))
(TR-9; AD-605206)

Starting with the assumption that stress is a functional of the deformation gradient history up to the instant of measurement, appropriate constitutive equations are formulated for the continuum mechanics of viscoelastic solids. Two major restrictions upon the form of the functional dependence of the stress arise from (1) the simultaneous time-dependent rotation of the deformed body and reference system which leaves the stress components unaltered; and (2) the symmetry which the material possesses in its reference state. Canonical forms for the constitutive equations are developed, approximations to the constitutive equations obtained, and time-independence introduced. E.E.B.

N65-17435# Naval Radiological Defense Lab., San Francisco, Calif.

ELF SIGNALS FROM SMALL CHEMICAL EXPLOSIONS

H. A. Zagorites 16 Nov. 1964 25 p refs
(USNRDL-TR-796; AD-455100)

In a series of more than 120 10-gram chemical explosions in air and in water, strong electric signals with frequency components below about 1.0 cps and durations up to 20 sec were observed consistently with a horizontal wire antenna near the explosions. However, signals generally were not observed during measurements with a magnetic loop antenna. From these tests, and other measurements made to isolate direct seismic and instrument signal sources, it was concluded that the electric signals recorded resulted principally from electric fields produced by the explosions and that the possibility exists that all signals observed arose from quasi-static electric fields in charged-particle explosion clouds postulated by existing theory. The electromagnetic nature of the signals was not verified, and additional experiments will be required to provide a conclusive answer regarding the source of these signals. Author

N65-17448# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.

DRIFTING FORCE AND MOMENT ON THIN SHIPS IN OBLIQUE LONG WAVES

Pung Nien Hu and King Eng Nov. 1964 27 p refs
(Contract Nonr-263(21))
(R-524; AD-456552)

A general expression for the drifting moment about the vertical axis of an oscillating ship in regular oblique waves is derived from the potential theory, following a similar procedure developed by Maruo for drifting force. Explicit analytical solutions for the drifting side force and yaw moment on thin ships in long waves are obtained in terms of simple elementary functions. The effect of the wave frequency, the draft of the ship, the displacement, and the phase angle of the ship oscillation are discussed. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-16340*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

THE SPACE, TIME, AND ENERGY DISTRIBUTIONS OF THE PROTON BEAM OF THE HARVARD UNIVERSITY SYNCHROCYCLOTRON

R. T. Santoro Jan. 1965 33 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-60600; ORNL-3722) OTS: HC $2.00/MF $0.50

The space, time, and energy distributions of the proton beam of the Harvard University Synchrocyclotron were measured. The spatial distribution was estimated from multiple-scattering approximations and measured by means of X-ray films and a beam profile counter telescope. Experimental results may be approximated by a gaussian function with $\sigma = \pm 0.28$ cm, with agreement between the observed results and the multiple-scattering estimates being favorable. Ninety-eight % of the protons were contained in an 0.84-cm beam radius. Analysis of the macroburst structure revealed a gross duty cycle of (4 ± 2)%, depending upon proton injection and extraction parameters. Oscilloscope observations of the microstructure showed that the protons occurred at regular 42-nsec intervals, with the width of the time distribution of protons being less than 7 nsec. With the delayed coincidence technique, the standard deviation of the time between adjacent bursts of protons was 1.4 nsec. The proton beam energy was determined from measurements of the proton range in copper and from time-of-flight measurements. The beam energy determined from the range measurements was 160.3 ± 0.6 MeV. Author

N65-16420# National Academy of Sciences—National Research Council, Washington, D. C. Subcommittee on Penetration of Charged Particles

STUDIES IN PENETRATION OF CHARGED PARTICLES IN MATTER

1964 389 p refs *Its* Nucl. Sci. Ser. Rept. No. 39
Available from Natl. Acad. of Sci.: $7.00

Collisions between ions and atoms are analyzed roughly, and are divided into two major groups. One group relates to the quantal perturbation case, where the phenomena may be described in terms of properties of the medium only. This case is discussed in some detail. Significant properties are, for example, dipole spectra of atomic systems, behavior of stopping at lower velocities, and applicability of free electron gas picture in atomic dynamics. The second group of collisions relates to ions of relatively low velocity, where collisions between ions and atoms may become nearly elastic, the energy

loss being largely kinetic energy of recoil atoms. For such collisions, classical mechanics may be used; similarity properties are based on this circumstance, and become different from those of the first group. Inelastic effects are also of importance and may be roughly estimated, as discussed briefly. Author

N65-16476*# Stanford Research Inst., Menlo Park, Calif.
COLLISION LIFETIMES, PHASE SHIFTS AND ORBITING PHENOMENA
1 Nov. 1963 28 p refs
(Contract NASr-49(07))
(NASA-CR-55132) OTS: HC $2.00/MF $0.50

Classical and quantal effects of atomic collisions under the influence of a short-range spherically symmetric potential are treated from the standpoint of phase shift significance. Phase shifts and classical functions are discussed, and simple potential properties illustrating classical collision lifetime behavior are examined. This examination included the parabolic barrier, the attractive power law, and the Lennard–Jones potential. Finally, bound states, barriers, semibound states, and behavior near a barrier maximum, are covered in a semiquantitative survey of quantal collisions. C.L.W.

N65-16519# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
THE EVALUATION OF OVERLAP INTEGRALS BETWEEN ARBITRARILY ORIENTED ATOMIC ORBITALS
Emmett B. Moore, Jr. May 1963 14 p refs
(D1-82-0246)

Formulas are presented for overlap integrals between atomic orbitals which are arbitrarily oriented. Two cases are discussed: (1) s and p orbitals located on centers at any specified positions with the p orbitals oriented in any direction in space, and (2) s and p orbitals located on centers at any specified positions with the p orbitals oriented along the x, y, or z axes. Only s and p orbitals are considered and it is assumed that the values of sigma and pi type overlap integrals are known from tables or computer programs. Author

N65-16523# Los Alamos Scientific Lab., N. Mex.
A METHOD FOR ESTIMATING FRACTIONAL YIELDS FROM LOW- AND MEDIUM-ENERGY NEUTRON INDUCED FISSION
Kurt Wolfsberg 12 Jan. 1965 26 p refs
(Contract W-7405-ENG-36)
(LA-3169)

A method is given for estimating fractional yields of products from low- and medium-energy neutron induced fission, based on experimental measurements of some fractional independent and cumulative yields. It involves the assumption that yields of products along beta-decay chains are described by a gaussian function with the same width (σ) for all mass numbers. Equations are given for estimating Z_p, the most probable charge. Fractional yields may be obtained from a table which lists fractional yields as a function of $Z - Z_p$. Author

N65-16648 European Organization for Nuclear Research, Geneva (Switzerland).
TESTS OF A METHOD TO STUDY HIGH-ENERGY NUCLEAR FISSION BY MEANS OF MICA DETECTORS, PART I
R. Brandt, Ch. Gfeller, and J. Zakrzewski 4 Dec. 1964 17 p refs
(CERN-64-49)

Sheets of natural mica interleaved with metal foils were exposed to large doses of high-energy protons to test a method of studying high-energy nuclear fission. After processing, the mica sheets were examined under an ordinary optical microscope, and it was found that the passage of the high-intensity proton beams through the mica did not affect its registration properties. The application of mica detectors in experiments of this kind may, however, be limited by the background of tracks produced in the mica itself. This background is tolerable for beam densities not exceeding about 10^{13} protons/cm^2. Author

N65-16650 European Organization for Nuclear Research, Geneva (Switzerland). Track Chamber Div.
PARTICLE PRODUCTION FROM 0.6 TO 1.2 GeV/c AT THE CERN PROTON SYNCHROTRON
J. Duboc, A. G. Minten, and S. G. Wojcicki 4 Jan. 1965 23 p refs
(CERN-65-2)

This report describes an intermediate energy beam, called k4, and the results of flux measurements for particles in the 600 to 1200 MeV/c momentum region. The beam was designed to meet the following requirements: (1) K^- in the momentum range from 800 to 1200 MeV/c, (2) stopping K^+ in hydrogen and heavy liquid bubble chambers, (3) $\bar{p}$ from 0 to 1200 MeV/c. These requirements could not be met by the previously existing low momentum beam k3. In that beam the vertical focusing was achieved by means of bending magnets, which, for the required bending angle of 41°, run into saturation at 800 MeV/c. To provide a proper shape of the magnetic field under these conditions, the magnets had to be shimmed. Because of this saturation the shimming could provide the correct compensation only at 800 MeV/c, which excluded the use of the beam also at the lower momenta. Accordingly, a new beam had to be designed. Author

N65-16665# Iowa State Univ. of Science and Tech., Ames. Ames Lab.
PACK2, A FORTRAN CRYSTALLOGRAPHIC MOLECULAR PACKING PROGRAM
Donald E. Williams Nov. 1964 33 p
(Contract W-7405-ENG-82)
(IS-1042) OTS: $2.00

Described is a computer program which performs an analysis of molecular packing in crystals. All space group symmetries are allowed. The packing energy of a molecular crystal structure, known or proposed, may be evaluated using appropriate nonbonded interatomic potential functions. For unknown crystal structures, the program may be used to assist the solution of the diffraction phase problem. In this application, the program minimizes the packing energy for a molecule of assumed dimensions by a steepest descent method. The adjustable parameters are the molecular translations and rotations, specified internal molecular rotations (subrotations), and the lattice constants. The program may also be used to study nonbonded interatomic potential functions. These functions can be evaluated by a comparison of the calculated parameters found by the program with the observed parameters for known crystal structures. Author

N65-16701 European Organization for Nuclear Research, Geneva (Switzerland). Div. of Research on Accelerators
STUDY OF A CLASS OF GUIDED ELECTROMAGNETIC WAVES: EH WAVES. APPLICATION OF DEFLECTOR STRUCTURES AS SEPARATORS OF PROGRESSIVE WAVES OF RELATIVISTIC PARTICLES [ETUDE D'UNE CLASSE D'ONDES ELECTROMAGNETIQUES GUIDEES: LES ONDES EH. APPLICATION AUX STRUCTURES DEFLECTRICES POUR LES SEPARATEURS A ONDE PROGRESSIVE DE PARTICULES RELATIVISTES]
(CERN 64-43)

A new type of guided electromagnetic waves, EH waves, for use in the solution of Maxwell equations, linearly independent of transverse electro- and transverse-magnetic (TE and TM) waves is introduced. The waves are propagated on an isotropic, homogeneous, and nondispersive media. The solutions of the equations, infinite in number, represent the components of the propagated electromagnetic waves in which the original properties are infinitesimally small. These waves must possess characteristics sufficiently similar to those TE and TM waves to allow their substitution as a new class in the solution of the Maxwell equations. The properties of orthogonality must be avoided in this analysis. The EH waves possess these characteristics and exercise a transverse deflector force proportional to the transverse gradient of the longitudinal-component E_z. It is necessary to use a gradient of E_z which is not zero. Trans. by R.E.S.

N65-16703 European Organization for Nuclear Research, Geneva (Switzerland). Proton Synchrotron Machine Div.
EFFICIENCY OF MULTI-TRAVERSAL TARGETS
H. G. Hereward, J. Ranft, and W. Richter 6 Jan. 1965 72 p refs
(CERN-65-1)

Computer programs are described for the determination of target efficiency and burst shape for various targets and target operations currently in use at the CERN proton synchrotron. Procedures, such as target sharing or the use of the rapid beam deflector, are included. The calculations are made using the Monte Carlo method. The input parameters include material, dimensions and positions of target and support, energy and mode of displacement of the internal proton beam, and specifications such as the number of primary particles, the duration of the burst, type of target operation, and type of printout. The initial proton parameters are calculated from the assumed density distribution of the internal beam. The effects of target traversal on the proton, wall losses, and the behavior difference in focusing and defocusing sections are taken into account. D.S.G.

N65-16717# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
RELATIVISTIC THEORY OF THE ELECTRODISINTEGRATION OF THE DEUTERON, I
M. Le Bellac, F. M. Renard, and J. Tran Thanh Van Jan. 1965 50 p refs
(Th-78)

The electrodisintegration of the deuteron $e + d \rightarrow e + n + p$ is treated in a fully covariant manner. Theoretical aspects of the problem are examined in detail. The transition amplitude is written in terms of 18 Lorentz invariant forms, satisfying the requirement of gage invariance. In a first application of this theory, only the nearest singularities are retained—those corresponding to the exchange of a nucleon and of a deuteron in the crossed and direct channels, respectively. The deuteron structure is included by using N-P-D vertex functions depending on the momentum transfer, while the final state interaction is treated by using dispersion relations for the multipole amplitudes. The theory makes it possible to remove some of the ambiguities which appear in the usual semirelativistic calculations. Author

N65-16718# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
APPLICATION OF THE HELICITY FORMALISM TO INELASTIC ELECTRON-SCATTERING
F. M. Renard, J. Tran Thanh Van, and M. Le Bellac Jan. 1965 24 p refs
(TH-79)

It is shown that helicity formalism can be applied to inelastic electron-scattering, where there are two strongly interacting particles in the final state, and this leads to simple cross-section and polarization formulas. The particular case of the electrodisintegration of the deuteron is treated in detail. Author

N65-16758# Massachusetts Inst. of Tech., Cambridge.
LABORATORY FOR NUCLEAR SCIENCE PROGRESS REPORT NO. 64
1 May 1964 137 p refs
(Contracts NASw-37; NASA-2053; NAS5-2952; NAS5-3205; Grant NsG-386)
(MIT-2098-64; AD-451242)

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N65-16844*# North Carolina Univ., Chapel Hill.
THE OPTICS OF A COSMIC RAY DETECTION SYSTEM USING A GAS FILLED CERENKOV RADIATOR
Robert Stuart Snyder (M.S. Thesis) 1963 45 p refs
(Contract NASw-59)
(NASA-CR-51513)

The use of a carbon dioxide gas Cerenkov radiation detector in a system to determine the charge distribution of the high-energy component of the primary cosmic radiation is studied. The variation of the index of refraction of carbon dioxide with pressure was measured, and this information used to select the velocity threshold of the particles to be detected. A Cerenkov detector containing carbon dioxide at 30 atmospheres pressure was operated successfully. Author

N65-16847 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TWO TERM APPROXIMATION IN THE THEORY OF SLOW COLLISIONS OF HEAT PARTICLES
G. V. Dubrovskiy *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 16–26 refs (See N65-16845 07-34)

Some connection between two-term approximation and other problems having been established, the dependence of transition probability on analytical properties of L_{12} and ω-functions is discussed. An integral equation for the transition coefficient was obtained. Examples listed lead to the formulation of conclusions about the dependence of the transition's probability on the colliding particles' velocity. Author

N65-16850 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPLEX MOMENTA AND POTENTIALS WITH REPULSIVE CORE
M. M. Perekalin *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 45-54 refs (See N65-16845 07-34)

Analytic properties of the nonrelativistic scattering matrix for potential with repulsive core in the complex angular momentum plane are investigated. Scattering matrix is a meromorphic function in the whole complex angular momentum plane. A continuation into the left-hand half-plane is a mere reflection of the right one. Several results on the location and the movement of the poles as the energy function are obtained. Asymptotic distribution of the poles was determined. Author

N65-16941# Rochester Univ., N. Y. Dept. of Physics and Astronomy
SINGULAR LOGARITHMIC POTENTIALS AND PERATIZATION
H. H. Aly, Riazuddin, and A. H. Zimerman 24 Jun. 1964 10 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-42)

Logarithmic singular potentials are considered to test the applicability of the peratization technique. It is shown that if one sums up the leading singular terms in each order of the perturbation series no finite results can be obtained. Author

N65-16950# Mound Lab., Miamisburg, Ohio.
GAMMA SELF-ABSORPTION IN A SPHERICAL DISTRIBUTED GAMMA SOURCE
K. W. Foster 5 Feb. 1965 12 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1219) OTS: $1.00

A precise solution to the self-absorption effect in a thick spherical gamma source was derived. Solutions to the general equation were obtained with the IBM 1620 computer by numerical integration of the relation. An examination of the values obtained showed that for source-to-detector distances greater than 10 times the radius of the source, the self-absorption factor can be represented as

$$S = \frac{3}{2\mu r}\left[\frac{1}{2} + \frac{e^{-2\mu r}}{2\mu r} - \frac{(1 - e^{-2\mu r})}{4\mu^2 r^2}\right]$$

Tables of this function from $\mu r = 0.02$ through 9.98 are given. Author

N65-16993*# Texas A&M Univ., College Station. Mathematics Dept.
HARTREE-FOCK SOLUTIONS WITHOUT EXCHANGE FOR NORMAL BERYLLIUM: DETAILED TECHNICAL SUPPLEMENT ON SPACE TECHNOLOGY PROJECT NO. 5 Progress Report
G. E. Abdo, C. W. Conatser, and E. R. Keown Aug. 1963 183 p refs
(Grant NsG-239-62)
(NASA-CR-51667) OTS: HC $5.00/MF $1.25

Beryllium is the first nontrivial, general case of an atom with complete groups of electrons. The report develops the Hartree-Fock equations from first principles for beryllium, and describes the numerical procedures employed to solve these equations. It contains flow diagrams and listings of the computer program along with instructions enabling a potential user to run the program. A physical interpretation of the Hartree-Fock potentials is given, as well as tables and graphs of the radial wave functions computed by the program. Author

N65-16996# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INTERACTIONS BETWEEN HYDROGEN AND OXYGEN ATOMS AND SURFACES Final Report, Oct. 1, 1962-Oct. 31, 1964
Joe N. Smith, Jr. 23 Oct. 1964 20 p refs
(Contract AF 49(638)-1192)
(GA-5762; AFOSR-64-2388; AD-608592)

The scattering of Kr, Ar, Ne, and D_2 beams from polycrystalline nickel targets is presented and compared with other investigations of heavy-particle scattering at a solid surface. Experiments support a model for the scattering mechanism in which a fraction of the incident molecules are scattered diffusely and the remainder are scattered preferentially. It is inferred that the slower particles in the incident beam contribute to the diffuse component while the faster particles are scattered preferentially. The spatial distribution of He and Ar beams scattered by gold target films was examined during and after evaporative deposition by mass spectrometry. By controlling the target temperature during deposition of the metal, varying degrees of crystallographic orientation and surface smoothness were obtained. The scattering of H_2, He, Ne, Ar, and Xe molecular beams from gold films was also examined during evaporative deposition. E.E.B.

N65-17031# Argonne National Lab., Ill. Physics Div.
UNITARY SYMMETRY FOR PEDESTRIANS (OR, I-SPIN, U-SPIN, V-ALL SPIN FOR I-SPIN)
H. J. Lipkin Sep. 1964 34 p refs
(Contract W-31-109-ENG-38)
(ANL-6942) OTS: $2.00

Unitary symmetry of elementary particles is described in a simple way, requiring no knowledge of group theory. The basic approach is that of Levinson, Lipkin, and Meshkov, and it uses SU_2 subgroups of the group SU_3. Unitary symmetry appears as a generalization of I-spin symmetry, in which three spins are defined in a symmetrical way and are all required simultaneously to be conserved. One of the three spins is I-spin; the other two, called U spin and V spin, define certain transformations between particles of different strangeness. Experimental consequences of the conservation of all three spins are calculated with conventional angular momentum algebra. The breaking of unitary symmetry by electromagnetic interactions and by the strong interactions producing mass splittings leads to consequences which are easily calculated with the use of the three spins and angular momentum algebra. Author

N65-17035# California Univ., Berkeley. Lawrence Radiation Lab.
EXCITATION OF 10-MeV H^0 ATOMS IN NEUTRAL AND CHARGED PARTICLE COLLISIONS

Klaus H. Berkner, Selig N. Kaplan, George A. Paulikas, and Robert V. Pyle 26 Oct. 1964 36 p refs
(Contract W-7405-ENG-48)
(UCRL-11460)

Ten-MeV hydrogen atoms with a distribution of excited states were produced by collisional dissociation of 20-MeV H_2^+ ions. The populations of the higher excited levels were removed by Lorentz ionization, and the levels were then repopulated by collisional excitation of the atoms in molecular or weakly ionized hydrogen targets. The populations of the levels $n = 6$ to 9 were determined by a second Lorentz ionization. For collisions with electrons and ions in hydrogen-plasma targets, cross sections for transitions from the levels $n = 5, 6$ to $n' = 6, 7, 8, 9$, and upper limits for the transitions $n = 1$ or 4 to $n' = 6$ or 7 were obtained. These are compared with calculations in the first Born, Bethe, and impact-parameter approximations; good agreement is found for all transitions, although those with $\Delta n = 2$ are somewhat larger than calculated. For molecular-hydrogen targets, transitions are observed from the sum of all levels with $n \leq 4, 5, 6$ to levels $n' = 6, 7, 8$, and 9. Cross sections for the individual transitions from $n = 5, 6$ to the levels $n' = 6, 7, 8$, and 9 were deduced from these results. These cross sections differ from those for charged-particle collisions in that they are smaller by about three orders of magnitude, and the ratios of cross sections with $\Delta n > 1$ to those of $\Delta n = 1$ are larger than in the charged-particle case. Author

N65-17042# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
FINAL STATE INTERACTIONS IN K_{e4}^+ DECAY
J. Iliopoulos Jan. 1965 35 p refs In ENGLISH; FRENCH summary

This article presents a model which permits the extraction of the longitudinal two-pion diffusion in the state where $L=0$, $I=0$, beginning with the experimental results on the decay of K_{e4}^+. In writing a formula of the Goldberger–Trieman type, the K_{e4} form factors are related to the partial amplitudes, of the diffusion $K\bar{K} \rightarrow 2_\pi$ which is calculated with the help of dispersion relationships. The interaction is approximated by a K^* exchange, and it is demonstrated that left hand coupling, very frequently negligible, is still very important for these amplitudes. A theory with two parameters is obtained: (1) the knowledge of the π-π scattering length, and (2) the value of the form factor $F_{KK^*\pi}(q^2)$ for $q^2 \simeq 5m^2$. It is possible to determine these parameters with the aid of the experimental spectrum of two pions, and the different asymmetries in the angular distribution of the products of disintegration. Trans. by R.E.S.

N65-17046# Nihon Univ., Tokyo (Japan). Dept. of Physics
DOMINANCE THEOREM IN CROSSING MATRICES IN ARBITRARY COMPACT GROUP
Naohiko Masuda [1964] 8 p refs
(NUP-64-20)

The new dominance theorem in crossing matrices in SU (2) and SU (3) groups is shown to hold generally in arbitrary compact groups. The absolute magnitude of the nonvanishing crossing matrix element between s-channel amplitude in the singlet state, and t-channel or u-channel amplitude in a given arbitrary multiplet state is never smaller than that of the crossing matrix element between s-channel amplitude in an arbitrary multiplet state. E.E.B.

N65-17059*# Johns Hopkins Univ., Baltimore, Md.
A MEASUREMENT OF THE DIFFUSION COEFFICIENT AND RADIATIVE LIFETIME OF NITROGEN MOLECULES IN THE $A^3\Sigma_u^+$ STATE Technical Report No. 1
Edward C. Zipf, Jr. Aug. 1963 7 p refs Submitted for Publication
(Grant NsG-193-62)
(NASA-CR-52469) OTS: HC $1.00/MF $0.50

Research to obtain a value for the diffusion coefficient and radiative lifetime of nitrogen molecules in the metastable $A^3\Sigma_u^+(v' = 0)$ state, by measuring the intensity of the (0,6) Vetard–Kaplan band ($A^3\Sigma_u^+ \rightarrow X^1\Sigma_g^+$) as a function of time and pressure in the afterglow of a microwave discharge in very pure nitrogen, is discussed. Measurements in the pressure range 0.1 to 10 mm Hg showed a metastable diffusion coefficient (D_m) of 0.202 $cm^2\ sec^{-1}$ at 760 mm Hg and 300° K, and a radiative lifetime (τ) of 0.9 sec. Comparison of the nitrogen self-diffusion coefficient, D_{11}, with D_m shows that nitrogen molecules in the excited $A^3\Sigma_u^+(v' = 0)$ state diffuse at a slightly slower rate than ground state molecules. P.V.E.

N65-17066*# Yale Univ., New Haven, Conn.
MUONIUM AND POSITRONIUM PHYSICS
J. M. Bailey and V. W. Hughes [1963] 17 p refs Presented at the 3d Intern. Conf. on the Phys. of Electron. and Atomic Collisions, London, Jul. 1963
(Grant NsG-1-59)
(NASA-CR-51187) OTS: HC $1.00/MF $0.50.

Atomic collision experiments were conducted on muonium and positronium. The primary concern was not with the details of energy loss of fast positive muons and positrons, since, even if muonium and positronium form, they rapidly break up again in collisions. However, below about 100 eV, five types of muon–atom collisions were considered: elastic collisions with and without spin-flip, muonium formation, atom-excitation (and ionization), and muon–molecule formation. Also, six types of muonium-other-atom collisions were considered: elastic collisions with and without spin-flip, muonium-excitation, muonium-ionization, muonium-atom attachment, and atom excitation (and ionization). For positrons and positronium, all of the above collision processes were considered, as well as positron annihilation. These experiments have resulted in the most unambiguous and precise values of the fine structure atomic constant α and have provided valuable information concerning many atomic collision processes. I.v.L.

N65-17108# Los Alamos Scientific Lab., N. Mex.
DISCRETE ORDINATES ANGULAR QUADRATURE OF THE NEUTRON TRANSPORT EQUATION
K. D. Lathrop and B. G. Carlson 12 Feb. 1965 47 p refs
(Contract W-7405-ENG-36)
(LA-3186) OTS: $3.00

Quadrature sets which satisfy complete symmetry conditions and various moment conditions are derived and tabulated, and critical thicknesses of one-dimensional slabs, spheres, and cylinders are calculated with these sets. Prescriptions for relaxing symmetry conditions and point location requirements are discussed, and orthogonal (Legendre–Tschebyschev) quadrature coefficients applicable in one-dimensional cylindrical or two-dimensional rectangular geometry are tabulated. Recipes are given for preparing biased direction sets, and a method of basing the bias upon material composition is outlined. Preliminary computational results indicate that double Legendre and half-range moment satisfying quadrature sets are most accurate in one-dimensional plane geometry, while even-moment satisfying, completely symmetric sets are recommended for other geometries. At the present state of the art of discrete ordinates computations, results indicate that boundary condition treatment and, in curved geometries, the handling of the ray-to-ray transfer (streaming) terms can affect accuracy as much as further refinement of angular quadrature. Author

N65-17130# Argonne National Lab., Ill. Metallurgy Div.
ON THE POSSIBILITIES FOR THERMAL NEUTRON IMAGE INTENSIFICATION
Harold Berger Nov. 1964 20 p refs
(Contract W-31-109-ENG-38)
(ANL-6917) OTS: $1.00

Possible techniques and materials for a thermal neutron image intensifier are compared. A vacuum-tube type intensifier, in which an electron image is accelerated and demagnified within an evacuated envelope, appears to present a useful possibility for a neutron image intensifier. Neutron scintillators for use in such an intensifier are compared, and it is concluded that a lithium-containing phosphor, enriched in Li-6, could be used to provide an intensifier useful for thermal neutron intensities of 10^5 n/cm^2-sec or higher. It is shown that such an intensifier would be capable of neutron image detection in the presence of an appreciable gamma-radiation background. Author

N65-17132# Rochester Univ., N. Y.
QUARK MODEL IN MOMENTUM SPACE AND HIGHER SYMMETRIES
Riazuddin and L. K. Pandit 14 Jan. 1965 15 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-70)

Momentum space approach in the framework of the Foldy–Wouthuysen representations for spin 1/2 and spin 3/2 particles is presented. A short résumé of the Foldy-Wouthuysen representation, its use in the relativistic completion procedure of Beg and Pais, and the symmetries underlying the three-quark model in a momentum space formulation are given. The free-field Hamiltonian is found to be invarient under a U(12) group. It is also shown how to write a four-fermion interaction which is U(6) invariant in the limit of large quark mass, but otherwise contains parts which reduce this invariance to just U(3). E.E.B.

N65-17133# Rochester Univ., N. Y.
ALGEBRAIC TABULATION OF THE CLEBSCH-GORDAN COEFFICIENTS FOR REDUCTION OF THE PRODUCT $(\lambda,\mu)\otimes(3,0)$ OF IRREDUCIBLE REPRESENTATIONS OF SU(3)
L. K. Pandit and N. Makunda 21 Jan. 1965 42 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-73)

Tables of Clebsch–Gordan coefficients of SU_3 for the reduction of the product $(\lambda,\mu)\otimes(3,0)$ of representations of SU_3 are constructed by use of the tensor method. Derivations of some crossing and symmetry relations for the SU_3 Clebsch–Gordan coefficients are given, and the Clebsch–Gordan coefficients for the product $(\mu,\lambda)\otimes(0,3)$ are related to those mentioned above. The phase convention used in compiling the tables is stated and explained. Author

N65-17134# Rochester Univ., N. Y. Dept. of Physics and Astronomy
THE Ca^{40} (He^3, α)Ca^{39} AND THE Ca^{40} (He^3, He^3)Ca^{40} REACTIONS BETWEEN 8.00 Mev AND 10.25 Mev
D. Cline, L. M. Blau, and W. Parker Alford 21 Jan. 1965 29 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-74)

Angular distributions have been measured for the Ca^{40} (He^3, α) Ca^{39} reaction leading to the ground and first three excited states of Ca^{39}. The ground state reaction was studied at laboratory energies of 8.00, 8.50, 9.00, 9.50, and 10.00 MeV and over an angular range from 7.5° to 170°. The excited state reaction data were measured at 9.00 MeV over an angular range from 7.5° to 120°. Excitation functions for the α_0 group have also been measured at laboratory angles of 45°, 60°, 75°, and 90° over the energy range from 8.00 to 10.25 MeV. The elastic scattering of He^3 from Ca^{40} was measured at laboratory energies of 8.50 and 9.50 MeV. Excitation functions of elastic scattering measured at angles of 45°, 60°, 75°, and 90° over the energy range from 8.00 to 10.25 MeV showed essentially the E^{-2} behavior expected for Rutherford scattering. The reaction cross sections were compared with the predictions of a zero range DW calculation using the JULIE code of the ORNL group. Author

N65-17193# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASIC PROPOSITIONS OF ELECTRON-TAUTOMERISM THEORY IN THE LIGHT OF NEW ELECTRON CONCEPTS
V. V. Razymovskiy 8 Dec. 1964 13 p refs Transl. into ENGLISH from Zh. Obshch. Khim. (Moscow), v. 34, no. 5, 1964 p 1693–1695
(FTD-TT-64-1050/1+4; AD-610341)

Electron tautomerism is explained as a continuously changing molecule within the limits of a preferential distribution of the electrons of specific atoms. The reactivity of individual portions of a molecule and the distribution of charges are determined by the residence time of the electrons in the field of these atoms. The X-ray studies of the NaCl crystal established the fact that a partially covalent bond of ionic molecules exists. It was also determined that the typical nonpolar molecule I_2 ionizes in solvents such as benzine, n-xylene, and isobutylene. Structural studies of polyhalogen radicals established the fact that regrouping of primary and secondary radicals leads to the formation of tertiary radicals, and thus verify the electron-tautomerism theory. G.G.

N65-17198# Rochester Univ., N. Y.
ZERO RANGE DISTORTED WAVE ANALYSIS OF THE O^{16} (He^3, α_0)O^{16} REACTION
W. Parker Alford, L. M. Blau, and D. Cline 20 Nov. 1964 14 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-65)

Measurements of the O^{16} (He^3, α) O^{15} reaction leading to the ground state of O^{15} and the elastic scattering of He^3 from O^{16} have been reanalyzed using an optical model in which the radius and diffuseness parameters are different for the real and imaginary parts of the potential well. This form of the optical model potential was found to be necessary in order to obtain agreement between DW calculations and measurements of the Ca^{40} (He^3, α) Ca^{39} reaction. The values of the parameters used for the incident He^3 channel were derived from elastic scattering data using the optical model search code HUNTER, the resulting values of which were essentially the same as those used in the DW analysis of the Ca^{40} (He^3, α) Ca^{39} group state reaction. With these new optical parameters, the DW calculations reproduced the shape of the measured angular distributions very well. Author

N65-17258*# General Dynamics, San Diego, Calif. General Atomic Div.
NEUTRON CROSS SECTIONS FOR U^{238}
G. D. Joanou and C. A. Stevens 22 Jan. 1965 22 p refs
(Contract SNPC-27)
(NASA-CR-54290; GA-6087) OTS: HC $1.00/MF $0.50

A revised set of neutron cross sections was prepared for U^{238}. The compiled and evaluated data were incorporated into the GAM-II slowing down program and into the GATHER-II thermalization program. The tables include (1) possible neutron reactions with U^{238} in the energy range 0.001 eV to 15.0 MeV; (2) resonance parameters; (3) comparisons of calculated values, and values from Hellstrand's empirical formulas for the resonance integrals of uranium metal, and of UO_2; (4) low energy cross sections for U^{238}; (5) neutron cross sections of U^{238} from 0.01 MeV to 15.0 MeV; (6) partial inelastic cross sections for U^{238}, and (7) Legendre expansion coefficients for U^{238}. R.L.K.

N65-17280*# Denver Univ., Colo.
EFFECTS OF ION BEAM EXCITATION ON CHARGE TRANSFER CROSS SECTION MEASUREMENTS
Robert C. Amme and Nyle G. Utterback Jul. 1963 15 p refs Presented at the 3rd Intern. Conf. on the Phys. of Electron. and Atomic Collisions, Jul. 1963
(Grant NsG-50-60)
(NASA-CR-60779) OTS: HC $1.00/MF $0.50

The charge-transfer cross sections for N_2^+ and O_2^+ ions in N_2 have been measured, both as a function of ion energy and ion-source electron energy. Ion energies were varied between 40 and 1000 eV, and the ion-source electron energy was varied between 16 and 24 eV. The resonant N_2^+ in N_2 cross section varied as a function of ion energy in the manner generally reported by other investigators. However, the cross section decreased 15 percent in going from 17 to 23 eV in electron energy. This is attributed to metastable ions in the beam which transfer inefficiently. In the O_2^+ in N_2 case, for electron energies below 18 eV, the cross section vs ion energy curve was strongly nonresonant, approaching zero cross section below 100 eV. For electron energies above 22 eV, a transfer cross section was quite evident which appeared to have resonance form. The metastable states likely to produce these results are discussed, along with their estimated transfer cross sections. Author

N65-17287*# Denver Univ., Colo.
IONIZATION CROSS SECTIONS FOR NEUTRAL HELIUM ATOMS ON HELIUM, NEON, AND NITROGEN
Nyle G. Utterback Jul. 1963 9 p refs Presented at the 3rd Intern. Conf. on the Phys. of Electron. and Atomic Collisions, Jul. 1963
(Grant NsG-50-60)
(NASA-CR-60777) OTS: HC $1.00/MF $0.50

The ionization cross sections for He atoms on impact with He and Ne atoms and N_2 molecules have been measured over the laboratory energy range from 40 to 1000 eV. The incident atomic beam was produced by the technique of ionization by electron impact, electrostatic acceleration, and neutralization by charge transfer. The measurements were carried out in a low-pressure parallel plate ionization chamber. Particular attention was paid to the problem of secondary electrons. The ionization cross sections obtained for the He-He and He-Ne interactions were smaller than 5×10^{-17} cm^2 over the energy range studied, and were thus one-to-two orders of magnitude smaller than the N_2-N_2, N_2-O_2, and O_2-O_2 cross sections studied earlier. The He-N_2 cross section, on the other hand, was found to be of the same order of magnitude as the N_2-N_2 cross section. Author

N65-17293# Brookhaven National Lab., Upton, N. Y.
NATURE OF MATTER. PURPOSES OF HIGH ENERGY PHYSICS
Luke C. L. Yuan, ed. Jan. 1965 150 p refs Sponsored by AEC
(BNL-888(T-360)) OTS: $1.75

Thirty theoretical physicists present their views on the objectives and problems of high-energy physics. The need for, and feasibility of, a super-high-energy accelerator in the energy range 200 to 1000 BeV are discussed. Detailed parameters of a design for an alternating gradient type of synchrotron in the multihundred BeV region are given. R.L.K.

N65-17295# California Univ., Livermore. Lawrence Radiation Lab.
ON THE POSSIBILITY OF DETECTING ANTINEUTRINOS FROM NUCLEAR EXPLOSIONS
S. F. Eccles and M. H. Blue 21 Aug. 1964 40 p refs
(Contract W-7405-ENG-48)
(UCRL-7855) OTS: $3.00

The possibility of detecting antineutrinos from an underground nuclear explosion was investigated for measurement of the yield of the nuclear device. A secondary consideration was that of doing basic physics experiments with the large antineutrino flux available from a nuclear explosion. Three detector types were studied, all based on the following interaction of antineutrinos with matter: $\bar{\nu} + p \rightarrow \beta^+ + n$. The main assumption made for the detection was that the detector would be placed far enough from the center of the blast to withstand the shock wave, and then to count for long times (of the order of a minute) after the explosion. Due to the inherently low counting rates expected from these detectors, and the geometry that is necessary in this type of experiment, it was concluded that none of the detectors considered would be economically feasible either to measure the yield of a nuclear device or to do basic physics experiments. Some speculations on possible different approaches to the detection of antineutrinos from nuclear explosions are made, and suggestions for further study are given. Author

N65-17311# Brookhaven National Lab., Upton, N. Y.
NEUTRON CROSS SECTION EVALUATION GROUP ANALYSIS OF (n2n) CROSS SECTIONS FOR NUCLEI OF MASS A > 30
S. Pearlstein Dec. 1964 50 p refs
(BNL-897(T-365)) OTS: $3.00

The ability of the statistical model of nuclear reactions to interpret measured (n,2n) cross sections was tested. Good agreement was observed for 22 nuclei having mass numbers greater than 30. The statistical model was then applied to all nuclei in this mass range to estimate both monoenergetic and fission spectrum averaged cross sections. Author

N65-17312# Brookhaven National Lab., Upton, N. Y. Neutron Cross Section Evaluation Group
OPTICAL MODEL ANALYSIS OF THE NEUTRON-SODIUM CROSS SECTION IN THE 1–4 MeV RANGE Newsletter No. 8
T. J. Krieger and S. Pearlstein Jan. 1965 8 p refs
(BNL-904(N-8)) OTS: $1.00

Fair fits to the experimental neutron differential elastic and total cross section of Na^{23} in the 1 to 4 MeV range are obtainable by least squares fitting of optical model digit computer calculations with the ABACUS II code. Further confidence in the optimum choice of parameter values so found is gained from the good fit which results when these values are used in a Hauser–Feshbach calculation of the partial inelastic scattering cross sections to individual excited states. The preliminary results reported indicate that the optical model can be applied with reasonable success to the analysis of the neutron–sodium

cross section in the 1 to 4 MeV range. In addition, they tend to encourage the application of the technique to other relatively light nuclei. Author

N65-17369# Argonne National Lab., Ill.
A RE-EVALUATION OF FISSION RATIOS MEASURED IN ZPR-III CRITICAL ASSEMBLIES
William G. Davey and Paul I. Amundson Oct. 1964 21 p refs
(Contract W-31-109-ENG-38)
(ANL-6941) OTS: $1.00

A recent comparison of measured and calculated fission ratios for 18 ZPR-III fast critical assemblies showed that the interpretation of these data contained ambiguities that suggested that the intercalibration of the fission chambers should be reexamined. Hence, an independent intercalibration was carried out in which the relative masses of fissile materials were estimated in terms of the fission rates in a thermal flux and the well-known thermal cross sections of certain fissile isotopes. The original mass calibrations were generally confirmed with corrections being of the order of only 3%, but U^{234} chambers required corrections of 9% to 12%. Additional small corrections of up to 1% were also established to allow for certain errors in the techniques used for the fission ratio measurements. The measured data were corrected, recompared with calculations, and shown to be in better agreement with calculated values. Author

N65-17406# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
A DESCRIPTION OF A ROUGH COMPUTATION OF THE SEPARATION ENERGY OF STRONGLY BOUND NUCLEONS
D. M. Brink and N. Sherman 12 Nov. 1964 36 p refs
(ISS-64/36)

This report contains the details of a rough but reasonable estimate of the adiabatic separation energies of nucleous ejected from the 1s shells of nuclei between Li^7 and Ca^{40}. The general assumptions and specific approximations are listed explicitly. The general expression for the energy is successively simplified using the approximations assumed. The calculational tricks used to compute matrix elements are described in detail and the results for the 1s shell are listed for reference. Author

N65-17408# Los Alamos Scientific Lab., N. Mex.
A METHOD OF MOMENTS FOR SOLVING THE NEUTRON TRANSPORT EQUATION
Bengt G. Carlson 8 Feb. 1965 48 p refs
(Contract W-7405-ENG-36)
(LA-3060) OTS: $2.00

This report gives an initial discussion of a method of moments in neutron transport theory that is an extension of the well-known spherical harmonic method though not based on orthogonal polynomials. Author

N65-17413# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
INTRODUCTION TO GROUP THEORY AND UNITARY SYMMETRY (A COURSE OF LECTURES GIVEN BY L. MAIANI AND G. DE FRANCESCHI). PART II: INTRODUCTION TO UNITARY SYMMETRY MODELS [INTRODUZIONE ALLA TEORIA DEI GRUPPI E ALLE SIMMETRIE UNITARIE (CICLO DI LEZIONI TENUTE DA L. MAIANI e G. DE FRANCESCHI). PARTE II: INTRODUZIONE AI MODELLI DI SIMMETRIE UNITARIE]
G. De Franceschi (Comitato Nazionale Per l'Energia Nucl., Frascati, Italy) 20 Apr. 1964 46 p refs *In* ITALIAN; ENGLISH Summary
(ISS-64-13)

The isotopic spin and eightfold-way models for strongly interacting particles are considered from a unified point of view. The main results of the latter theory as well as the mass formula and the ω-ϕ mixing problem are also reported. Author

N65-17488# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD MAY–AUGUST, 1964 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE MAGGIO–AGOSTO, 1964
L. Gorini et al 5 Sep. 1964 46 p In ITALIAN and ENGLISH
(ISS-64/33)

A series of 16 lectures, on subjects ranging from genetics to nuclear physics, is presented. Subjects covered in the different lectures include streptomycin, taxonomy, DNA, electrophoresis, electron accelerators, pion production, electron–nucleon scattering, the van der Waals equation, proton synchrotron work, ultraviolet irradiation, nuclear physics, and strong interactions. D.E.W.

N65-17495# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics
FURTHER RESULTS ON p-p PHASE SHIFTS AT 50 MeV
Norio Hoshizaki and Wataro Watari (Osaka City Univ.) Nov. 1964 6 p refs
(RIFP-42)

A phase shift analysis at 50.0 MeV was performed by use of all available p-p data in the energy range 47.8–52 MeV. The data were analyzed to get the approximate phase shifts at 50.0 MeV, and the quantities from the potential model, the one-boson-exchange model, or the energy dependent phase shift solution were calculated. This resulted in practically model-independent values. The phase shifts at 47.5 or 51.8 MeV are given by approximations and the observables X_{calc} were calculated from these phase shifts. G.G.

N65-17497# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
DIFFERENTIAL NEUTRON THERMALIZATION Annual Summary Report, Oct. 1, 1963–Sep. 30, 1964
W. L. Wittemore Washington, AEC, 20 Oct. 1964 113 p refs
(Contract AT(04-3)-167)
(GA-5554) OTS: $4.00

The Neutron Velocity Selector has been exploited to study the inelastic scattering of monoenergetic neutrons in a variety of materials. The scattering into various angular directions between 30° and 150° has been studied for incident neutrons with energies up to 1.0 eV. Because of the ability of this apparatus to study details of single scattering events with neutrons having energies significantly higher than are available with reactor-based experiments, most of the present work was done for $E_0 > 0.20$ eV. The exact incident energy was chosen to optimize the ability to study various chemical rotation and vibration levels in this higher energy region. The technical details of the experimental apparatus are discussed. Separate discussions are devoted to (1) neutron scattering by liquid parahydrogen, (2) the scattering kernel for polyethylene, (3) neutron interactions in zirconium hydride, and (4) hydrogen and deuterium binding in zirconium, yttrium, and lanthanum. Author

N65-17502# Stanford Univ., Calif. High Energy Physics Lab.
ELECTRON SCATTERING BY CALCIUM AT 250 MeV
M. Croissiaux, R. Hofstadter, A. E. Walker, M. R. Yearian, D. G. Ravenhall (Illinois Univ., Urbana) et al 15 Sep. 1964 22 p refs Sponsored in part by Navy and NSF
(HEPL-347; AD-608167)

The doubly magic nucleus of Ca^{40} was investigated by the electron scattering technique at an incident energy of 250 MeV. The elastic scattering behavior was resolved from the inelastic scattering, and absolute data on cross sections were obtained for both types of events. In the case of the elastic scattering the first and second diffraction features were observed and measured. A comparison was made of the elastic data with theoretical calculations based on a phase shift analysis for certain assumed models of the nuclear charge density distribution. Such an analysis with present and earlier data permits the determination of the radius and skin thickness of the Ca^{40} nucleus. An investigation of the dependence of the density distribution on a third parameter indicates that a Fermi distribution, or models close to this type, are required to fit the experimental data. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-16353 Joint Publications Research Service, Washington, D.C.
HIGH-FREQUENCY WAVES IN A PLASMA DRIFTING IN A MAGNETIC FIELD
G. Kh. Kamenetskaya and M. S. Kovner *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 14–24 refs (See N65-16351 07-23) OTS: $6.00

The propagation of waves in a drifting magnetoactive plasma is investigated in a quasi-hydrodynamic approximation. In such a case, the number of normal waves turns out to be equal to 8. The dispersion characteristics are investigated, and the results are discussed. Author

N65-16354 Joint Publications Research Service, Washington, D.C.
TENSOR FOR THE EFFECTIVE DIELECTRIC CONSTANT OF AN INHOMOGENEOUS MAGNETOACTIVE PLASMA
Yu. A. Ryzhov and V. V. Tamoykin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 25–32 refs (See N65-16351 07-23) OTS: $6.00

An expression is obtained for the tensor for the effective dielectric constant of a weakly inhomogeneous magnetoactive plasma. A specific evaluation is given for the case when the dimensions of the inhomogeneities are small in comparison with the wavelength of the propagating radiation. Author

N65-16355 Joint Publications Research Service, Washington, D.C.
POTENTIAL OSCILLATIONS OF A STRONGLY INHOMOGENEOUS RAREFIED PLASMA
V. V. Arsenin *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 33–42 refs (See N65-16351 07-23) OTS: $6.00

Beginning with the previously found tensor for the dielectric constant of a rarefied plasma with arbitrary degree of inhomogeneity, an equation is obtained for the potential oscillations of such a plasma. It is shown that shortwave perturbations in a rarefied plasma are potential in nature. The oscillations of a strongly inhomogeneous plasma with frequencies of the order of the ion gyrofrequency are considered. Author

N65-16356 Joint Publications Research Service, Washington, D.C.
MECHANICAL GENERATION OF CERENKOV RADIATION IN AN IDEALLY CONDUCTING ELASTIC MEDIUM BOUNDED BY A VACUUM. I
S. Kaliskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 43–57 refs (See N65-16351 07-23) OTS: $6.00

Cerenkov radiation is considered in a perfectly conducting elastic medium filling the half-space bordering on vacuum under the mobile force action on the medium surface when the external constant magnetic field is perpendicular to the plane of motion. The cones of Cerenkov radiation were determined at supermagnetosonic and intermagnetosonic velocities; the radiation intensity was found without taking the dispersion into account. The stationary perturbation is shown to exist before the cones fronts of the propagation of the mechanical and electromagnetic perturbations in the case of supermagnetosonic velocity. Author

N65-16357 Joint Publications Research Service, Washington, D.C.
MECHANICAL GENERATION OF CERENKOV RADIATION IN AN IDEALLY CONDUCTING ELASTIC MEDIUM BOUNDING A VACUUM. II
S. Kaliskiy *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 58–79 refs (See N65-16351 07-23) OTS: $6.00

The problem has been considered using anisotropic orientation of a constant magnetic field. The general method of solution is similar to that previously given, but qualitatively and quantitatively there are real differences between them. Author

N65-16358 Joint Publications Research Service, Washington, D.C.
SCATTERING OF LIGHT BY A CHARGE MOVING IN A MEDIUM
A. Gaylitis *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 80–87 refs (See N65-16351 07-23) OTS: $6.00

The scattering of a transverse electromagnetic wave by a discrete charge moving in a transparent medium with both slower and faster than light speeds is considered. It is shown that with an increase in the charge velocity as it approaches the speed of light in the medium, the scattering of light is sharply increased. For faster than light velocities, the scattering leads to a widening in the lines of Cerenkov radiation. Author

N65-16359 Joint Publications Research Service, Washington, D.C.
KINETIC THEORY OF A PLASMA WAVE GUIDE IN A STRONG MAGNETIC FIELD
A. N. Kondratenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1965 14 Jan. 1965 p 88–93 refs (See N65-16351 07-23) OTS: $6.00

On the basis of a kinetic equation with a self-consistent field, the propagation of electromagnetic oscillations in a cylindrical plasma waveguide bounding a vacuum and located in a strong magnetic field is considered where "near" particle collisions are ignored. The cases of isothermic and

nonisothermic plasma are examined. Values for the phase velocity and the attenuation coefficients are found as a function of the waveguide radius, the temperature of the plasma particles, and the frequency of the propagating wave. Author

N65-16360 Joint Publications Research Service, Washington, D. C.
TRANSITION RADIATION IN A MAGNETOACTIVE PLASMA
V. M. Yakovenko *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 94–103 refs (See N65-16351 07-23) OTS: $6.00

The transient radiation problem in magnetoactive plasma is solved by the kinetic equation method. The expression was found for the spectral density of radiation into vacuum under the condition of the specular electron reflection from plasma surface. The peculiarities of the transient radiation in magnetoactive plasma are discussed. Author

N65-16361 Joint Publications Research Service, Washington, D. C.
ONE MODIFICATION OF THE GEOMETRIC OPTICS METHOD
Yu. A. Kravtsov *In its* Izv. VUZov: Radiophys., Vol. VII, No. 4, 1964 14 Jan. 1965 p 104–117 refs (See N65-16351 07-23) OTS: $6.00

The solution of a scalar wave equation can be specially fitted to the field's description near the caustic being written as a product of an exponential and Airy functions arguments of which are ψ_1 and ψ_2 correspondingly. In this case the problem is reduced to the solution of the eikonal equation for a certain function Ψ with ψ_1 and ψ_2 as its arguments. Consequently, the eikonal equation for function Ψ coinciding with the wave phase only at a large distance from the caustic is valid in all the space including the caustic. Author

N65-16362 Joint Publications Research Service, Washington, D.C.
CONTRIBUTION TO THE THEORY OF COMBINATIONAL RADIATION IN STRONG FIELDS
Yu. G. Khronopulo *In its* Izv. VUZov: Radiophys., Vol. VII No. 4, 1964 14 Jan. 1965 p 118–126 refs (See N65-16351 07-23) OTS: $6.00

Approximate equations describing the processes of combinational and binary radiation and absorption, taking into account the effects of saturation, are derived from the kinetic equation for the density matrix by means of the method of averaging. The case of a combinational interaction between fields in a system with nonequidistant planes is analyzed for illustration. The magnitudes of fields, necessary for saturation in magnetic and electric dipole interactions between medium and the field, are evaluated on the basis of obtained solutions. Author

N65-16407# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
AN EXPERIMENTAL STUDY OF THE ENERGY EXCHANGE IN THE COLUMN OF AN ELECTRIC ARC WITH RADIAL GASFLOW INTERACTION
Harold F. Elliott and Raymond V. Gomez (M.S. Thesis) Aug. 1964 86 p refs
(GE/EE/64-6; AD-608888)

An arc device was constructed, tested, and used to study the effects of radially injecting nitrogen gas into the column of a dc arc. The device consists basically of a single tungsten cathode, a six-element copper anode, and a copper constrictor with an adjustable axisymmetrical radial gas injection jet. All elements are water cooled. The assumption is made that the cathode and anode fall regions are not affected by the gas injection. The power transferred to the gas is determined by measuring the increased power input to the arc device during gas injection, and making an appropriate correction for the heat lost in the constrictor. The mass flow of the nitrogen is monitored by a locally constructed coiled capillary flowmeter. Injection velocities are varied from zero to sonic. For arc powers in the range of 7 to 28 kW and mass flows up to 10 lb/hr, gas enthalpies as high as 9000 Btu/lb are attained with a device efficiency up to 63 percent. Approximate average gas temperatures are from 5300° to 7000° K. The basic arc device is shown to be effective, although modification of the anode casing and the constrictor is suggested. Author

N65-16479*# Illinois Univ., Urbana. Engineering Experiment Station
THE IMPEDANCE OF A SHORT DIPOLE ANTENNA IN A MAGNETOPLASMA
K. Balmain May 1963 171 p refs Submitted for Publication (Grant NsG-395)
(NASA-CR-50496) OTS: HC $5.00/MF $1.00

A formula for the impedance of a short, cylindrical dipole in a magnetoplasma is derived using quasi-static electromagnetic theory. The formula is valid in a lossy plasma and for any dipole orientation with respect to the magnetic field. It is shown that the quasi-static theory can be interpreted in terms of scaled coordinates, and that a cylindrical dipole in a magnetoplasma has a free space equivalent to a distorted shape. The dipole impedance is found to have a positive real part under lossless conditions when the quasi-static differential equation is hyperbolic; this indicates that the quasi-static theory predicts a form of radiation. The effects of plasma wave excitation and various assumed current distributions are discussed. Laboratory measurements of monopole impedance are found to agree fairly well with the theoretical calculations. Author

N65-16481*# Naval Research Lab., Washington, D. C. Radiation Div.
STARK PROFILE MEASUREMENT OF THE LYMAN-α AND LYMAN-β LINES OF HYDROGEN
R. C. Elton 17 Jul. 1963 35 p refs
(NASA Order R-9)
(NASA-CR-52912; NRL-5967) OTS: HC $2.00/MF $0.50

A T-type electromagnetic shock tube was used for the detailed study of Stark broadened lines in the vacuum ultraviolet. Measurements of the Lyman-α profile from an optically thin region (0.03% admixture of hydrogen in 40 mm-Hg helium) indicated agreement to within 10% with recent calculations which included the broadening effects due to electron impacts, as opposed to the Holtsmark theory which differs by a factor of ~3 on the wings when the theoretical curves are normalized at equal slope. A temperature of $(20.5 \pm 1.6)10^{3°}$ K was determined from a line-to-continuum ratio measurement for helium. Density measurements from the visible continuum gave $N_e = (3.6 \pm 0.4)10^{17}$. The Rankin–Hugoniot equations predicted $N_e = (4.8 \pm 1.9)10^{17}$ and $T = (20.0 \pm 1.0)10^{3°}$ K from the measured shock velocity. A calculated spectral emissivity of 0.09 ± 0.06 at 1217.7Å compares with 0.10 ± 0.02 as found experimentally by adding a known amount of hydrogen until saturation occurs. Similar measurements on the Lyman-β line support these results. Author

N65-16482*# Naval Research Lab., Washington, D. C.
IONIZATION RATES AND IMPURITY RADIATION LOSSES IN θ-PINCHES

Alan C. Kolb and R. W. P. Mc Whirter (U.K. Atomic Energy Authority, Culham) [1963] 52 p refs
(NASA Order R-9)
(NASA-CR-50349) OTS: HC $1.00/MF $0.50

Calculations are presented for the influence of small impurity concentrations on energy balance and electron temperature during magnetic compression of a deuterium plasma. The rate equations that describe the ionization are based on the Corona Plasma model in much the same way as has been done earlier for a homogeneous plasma. The radial temperature and density distributions were obtained numerically by coupling the Hain–Roberts two-fluid, hydromagnetic equations to the Corona equations. The ionization of up to four different impurities, i.e., O, C, N, Ne, can be taken into account. Radiation losses were included in the electron energy-balance equation. Author

N65-16489*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE NORMAL MODE APPROACH TO THE SOLUTION OF THE INITIAL VALUE PROBLEM FOR PLASMA OSCILLATIONS Scientific Report No. 196
P. E. Bolduc 10 Oct. 1963 103 p refs
(Grant NsG-134-61)
(NASA-CR-52405) OTS: HC $4.00/MF $0.75

The first-order determination of the properties of a plasma immersed in a constant, external, magnetic field is carried out. Normal mode analysis is utilized in an initial value problem based on plane symmetry. Methods for determining expansion coefficients for the transverse and longitudinal modes, separately, are deduced. Author

N65-16490*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics
KINETIC THEORY OF THE CLASSICAL ELECTRON GAS IN A POSITIVE BACKGROUND. I: EQUILIBRIUM THEORY
Ralph L. Guernsey Oct. 1963 39 p refs
(Grant NsG-220-62)
(NASA-CR-52515; BN-337) OTS: HC $2.00/MF $0.50

An approximation scheme is developed for calculating the equilibrium properties of a system containing both short-range and weak long-range interactions. The results are applied to the calculation of the pair correlation and equation of state for an electron gas in a neutralizing background. Although the starting point is the B-BG-K-Y hierarchy, the short-range divergence usually encountered in the "dynamic" approach is avoided, and the results (calculated through second order in the plasma parameter) are found to be in agreement with previous calculations by diagrammatic methods. Author

N65-16492*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science
VELOCITY DISTRIBUTIONS OF THE INTERPLANETARY PLASMA DETECTED BY EXPLORER 10
F. Scherb [1963] 48 p refs
(Grant NsG-386)
(NASA-CR-55557) OTS: HC $2.00/MF $0.50

The Explorer 10 satellite carried out measurements on magnetic fields and plasma for about 50 hours along a trajectory that extended to an apogee of 47 earth radii. The plasma probe instrumentation and measurement procedure are described, and the results of an analysis of the plasma data with regard to the velocity distribution and angular distribution of the plasma ions are presented. Calculations are based on a simple model of ion velocity distribution in which it is assumed that, in a frame of reference that moves with the bulk velocity of the plasma, the ions have an isotropic Maxwellian velocity distribution characterized by the temperature. Results of the calculations are compared with observed signals, and the values of ion temperature, bulk velocity, and bulk energy, which fit reasonably well with observations, are presented. D.S.G.

N65-16552*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANOMALOUS DIFFUSION AND INSTABILITIES OF AN ARGON PLASMA IN A STRONG MAGNETIC FIELD
Che Jen Chen 15 Dec. 1964 14 p refs
(Contract NAS7-100)
(NASA-CR-60609; JPL-TR-32-695) OTS: HC $1.00/MF $0.50

The rate of electron density decay with time in an argon discharge tube energized with a capacitor bank of energy up to 3000 J is measured by using electron continuum intensity, ion current probe, and microwave techniques. The discharge tube is oriented along a magnetic field up to 30 kG. The electron temperature decay is obtained by the spectral-line intensity ratio method. The oscillation or instability in the plasma is monitored with electrostatic and magnetic probes. The coefficient of ambipolar diffusion is evaluated from the decay data obtained in the diffusion-dominated region. The data thus obtained indicate that the coefficient of ambipolar diffusion agrees with the prediction of the collision theory up to the magnetic field of about 1000 G. Beyond 1000 G the onset of oscillations is detected and the coefficient of diffusion is much higher than the collision-theory prediction. For $B > 1000$ G, the coefficient of diffusion varies as B^{-1} and the absolute values are quite close to Bohm's. It is thought that the mechanism responsible for the anomalous diffusion is the onset of an instability in the plasma, which at low magnetic field is probably dominated by ion oscillation and at high magnetic field by the so-called universal instability. The critical field for the onset of the instability in the present experiments (pressure of gas $\approx 500\mu$ Hg) is about 1000 G. Author

N65-16560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF QUANTUM-PLASMA
G. Kelbg 2 Dec. 1964 8 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 12, no. 3–4, 1963 p 219–224
(FTD-TT-64-425/1; AD-455007)

The quantum static condition sum of an N-particle system in case of far-reaching intermediate molecular exchange effects was calculated. The process can be applied when the potential possesses the Fourier-transform. By introducing quantum potentials which depend upon temperature and Planck's quantum, it is possible to use classic equations and develop formulas for the free energy and radial distribution function. In the case of a plasma, a nonsingular potential function that deviates near the zero point appears in place of the Coulomb-potential, whose value is determined at the zero point by the reciprocal value of the thermal wave length. Author

N65-16565# ARO, Inc., Arnold Air Force Station, Tenn.
OPTIMIZATION OF MHD CROSSED-FIELD ACCELERATORS AND GENERATORS
Leon E. Ring Arnold Eng. Develop. Center, Jan. 1965 63 p refs Presented at the Fifth Symp. on Eng. Aspects of Magnetohydrodyn., MIT, 1–2 Apr. 1964
(Contract AF 40(600)-1000)
(AEDC-TDR-64-278; AD-456163)

A general theory is presented for the optimization of MHD crossed-field accelerators and generators. The optimization includes matching the channel inlet conditions to the plasma source and exit conditions to exhaust or test flow requirements. Variable electrical conductivity and real gas effects are included. It is shown that for minimum length both accelerators and generators have the characteristic of heavy loading near the entrance, light loading in the middle, and heavy loading again near the exit. It is found that a substantial reduction in channel length can be achieved by optimization of a high performance accelerator or generator. Author

N65-16594# National Aeronautics and Space Administration, Washington, D.C.
BOUNDARY CONDITIONS AT THE SURFACE OF CONTACT BETWEEN AN IONIZED GAS AND A SOLID [O GRANICHNYKH USLOVIYAKH NA POVERKHNOSTI KONTAKTA IONIZOVANNYY GAZ-TVERDOYE TELO]
G. A. Lyubimov Feb. 1965 10 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 4, 1963 p 78–82
(NASA-TT-F-296) OTS: HC $1.00/MF $0.50

It is shown how the boundary conditions at the electrode of a conducting channel can be formulated with allowance for the ordinarily disregarded physical properties of the electrode material. It is asserted, moreover, that an exact formulation of the boundary conditions depends on the distribution of the electrical variables in an electrode boundary layer whose thickness is less than the electron mean free path. Since there does not exist at the present time a solution to the near-electrode layer problem, formulation of the boundary conditions must rely on certain assumptions regarding the electron emission mechanism and the nature of the electrode boundary layer. The degree to which the assumptions fit the true substance of the problem must be verified for each specific instance. As an illustration of the proposed method, calculations are made for the volt-ampere curves for a channel, given extremely coarse assumptions as to the behavior and physical properties of the electrode material. Author

N65-16638# Space Technology Labs., Inc., Los Angeles, Calif. Physical Research Lab.
A STUDY OF PLASMA STABILITY IN MICROWAVE CAVITIES BY A FREQUENCY-SHIFT ANALOG
Robert A. Swanson [1950] 18 p refs
(Contract AF 04(647)-309)
(STL-TR-59-0000-00812; AD-608796) OTS: $1.00

Weibel has discussed the stability of a perfectly conducting plasma surface in an rf cavity in terms of a function x defined by $\Delta p = p_o x \Delta s$ where p_o is the equilibrium radiation pressure, and Δp is the local pressure change due to an outward displacement Δs of the plasma surface. The x has been calculated by Weibel for the case of a cylindrical plasma in a coaxial cylindrical cavity, for Δs given by $\Delta s = \epsilon$ a sin $n\theta$ sin hz. For such displacements x depends only on n and h. The calculation was done by solving Maxwell's equations to first order in ϵ and evaluating the stress tensor on the displaced plasma surface. In this report, the definition of x is generalized and a relation is deduced between x and the resonant frequency of the cavity which has the plasma surface as the inner boundary. This relation is used to study experimentally the stability of a plasma surface in a reentrant cavity. Author

N65-16642# Perkin-Elmer Corp., Norwalk, Conn.
CRYSTALS FOR OPTICAL MASER APPLICATION Final Report, 1 Jul. 1963–30 Sep. 1964
G. W. Dueker 16 Dec. 1964 25 p refs
(Contract DA-36-039-AMC-03365(E))
(PE-TR-M7920)

A total of 78 optical components were fabricated, coated, or tested and delivered. One ruby crystal was cut into a number of thin sections and the index gradient in each section mapped, using multiple beam interferometry. The chromium concentration of the sections was measured along the longitudinal axis. Index gradient was uniformly distributed along the sample, while chromium concentration varied in layers. Author

N65-16645# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Energiewandlung und Elektrische Antriebe
ON VARIOUS METHODS OF GENERATING PLASMA IN THERMIONIC CONVERTERS [VERGLEICHENDE BETRACHTUNGEN UBER DIE PLASMAERZEUGUNG IN THERMIONISCHEN KONVERTERN]
K. Schuster Oct. 1964 23 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-27; DVL-375) Available from ZLDI, Munich: 6.70 DM

Various possibilities of generating a plasma in thermionic converters are discussed: surface ionization, ionization by low voltage arcs, by photon processes, by auxiliary discharges, by an electron gun, by β-rays of radioactive krypton, by fission fragments, and by γ-rays. The high-pressure Cs converter combines high efficiency with excellent power output and reliability. However, the output voltage is low on account of the voltage drop within the plasma, and the necessarily very small gaps and the heat conduction of cesium vapor are intrinsic disadvantages. The capillary cathode indicates new ways for utilizing the surface ionization. In noble gas converters, ion production is most efficient by ionization with an electron gun. There is the possibility of activating the collector by a Cs-covering. Thus, some of the Cs converter advantages and of the noble gas converter might be combined. Author

N65-16649 European Organization for Nuclear Research, Geneva (Switzerland).
SOME STUDIES OF HIGH VOLTAGE VACUUM BREAKDOWN ACROSS LARGE GAPS. INVESTIGATION OF THE PROPERTIES OF OXIDE-COATED ALUMINUM ELECTRODES (APPLICATION TO ELECTROSTATIC SEPARATORS)
Francois Rohrback 9 Nov. 1964 43 p refs
(CERN 64-50)

Tests of high-voltage breakdown across large gaps (1 to 10 cm) were performed in the pressure range 10^{-8} to 10^{-3} torr with different types of electrodes: glass and oxide-coated aluminum as cathodes, and aluminum and stainless steel as anodes. Small electrodes (300 cm^2) and large electrodes (15000 cm^2) were tested in two different vacuum tanks. Electric fields well above 100 kV/cm were maintained even with the large electrodes and after a very large number of sparks. Further fundamental theoretical investigations were carried out to try to understand the influence of the pressure on the vacuum breakdown voltage. Author

N65-16786# AVCO-Everett Research Lab., Everett, Mass.
SEGMENTED ELECTRODE LOSSES IN MHD GENERATORS WITH NONEQUILIBRIUM IONIZATION—II
Jack L. Kerrebrock Jan. 1965 39 p refs
(AVCO-Everett Res. Rept.-201)

In MHD generators designed to produce nonequilibrium ionization by electron heating, the electrical conductivity may

be very high near segmented electrode walls, where the concentrated dissipation produced by blockage of the conduction current at the surface of the insulator may produce much higher electron temperatures than exist in the bulk of the gas. The nonuniform conductivity tends to cause Hall current shorts which increase the dissipation and the conductivity near the electrodes. The effect of this phenomenon on the performance of segmented electrode generators is analyzed. One conclusion of the analysis is that generators with rather coarse segmentation are less subject to this type of loss than are generators with very fine segmentation, and will therefore yield larger electron temperatures. A second conclusion is that, to maximize the electron temperature rise, operation at high Mach number, but rather low Hall parameter, is desirable. Author

N65-16794# Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER Seventh Quarterly Progress Report, 15 Jun.–14 Sep. 1964
M. A. Allen, C. S. Biechler, P. Chorney, and H. S. Maddix [1964] 59 p refs
(Contract DA-36-039-AMC-00076(E); ARPA Order 331-62)
(Rept.-7; AD-452044)

Some computations of the small signal propagation constants are presented. The large signal theory is applied to interaction at subharmonics of the plasma frequency, showing the plasma interaction to be an excellent frequency multiplier. Plasma generation experiments were conducted on two PIG discharges with a common reflector, to be used in a coupling experiment. A usable plasma of this type has not yet been developed. Amplifier experimental results are presented showing gain in the high-voltage-discharge operating mode. In the latest experimental vehicle over 12 kW of peak rf power was achieved. Author

N65-16801# Raytheon Co., Waltham, Mass. Research Div.
STUDY OF MICROWAVE GENERATION BY MEANS OF ELECTRON BEAM INTERACTION WITH ANISOTROPIC MEDIA Fifth Quarterly Progress Report No. 5, 1 Jul.–30 Sep. 1964
R. J. Briggs, S. F. Paik, and J. K. Silk [1964] 34 p refs
(Contract DA-36-039-AMC-02362(E))
(S-686; AD-452108)

A theory of a resonance absorption mechanism which provides a plausible explanation for observed damping is further advanced to predict hitherto unknown attenuation of waves on a solid cylindrical plasma column. To check the validity of the theory, the theoretical results are compared with reported experimental work. It can be shown, for instance, that the lack of experimental confirmation of the existence of the so-called cyclotron-mode backward wave in the plasma column may be explained in terms of the predicted resonance absorption mechanism. In order to check whether such a damping mechanism is indeed responsible for the observed damping in our experiments, a new experimental tube was constructed to measure the radial density variation in the annular plasma column. The design and construction of the experimental tube with a movable probe is discussed. Some preliminary results on the variation of the density profile with the magnetic field are also presented. Author

N65-16804# Aix-Marseilles Univ. (France). Inst. for Fluid Mechanics
SHOCK WAVES IN ARGON [ONDES DE CHOC DANS L'ARGON]
M. Billiotte and H. Guénoche Jun. 1963 43 p refs In FRENCH

When calculating the state of a gas after the passage of a shock wave, it is necessary to take into account the molecular structure of the gas. For a monatomic gas such as argon, the mathematical basis of the calculation of the thermodynamic variables of the gas after the passage of the shock wave is presented. The calculated values of these thermodynamic variables (for various values of temperature and for pressure behind the shock) are shown in tabular form. Author

N65-16833*# Advanced Kinetics, Inc., Costa Mesa, Calif.
LABORATORY SIMULATION STUDIES OF OUTER SPACE PHENOMENA First Quarterly Status Report, Apr. 15–Jul. 15, 1963
R. S. Lowder, S. W. Lee, R. W. Waniek, D. S. Harris, and H. J. Gilsdorf 15 Jul. 1963 12 p refs
(Contract NASw-702)
(NASA-CR-50645)

Work was concentrated on photographic observation of the plasma interaction with the magnetic dipole field. Sequences of pictures have been taken of the dynamics of the plasma flow, both with and without the dipolar magnetic field. In these photographs, one sees the arrival of the plasma and the stopping of the plasma at a point several centimeters away from the axis of the dipole. In addition to the photographs, well-shielded magnetic probes have been used to measure the magnetic field in the equatorial plane on the plasma-gun side of the dipole. These probes have observed a field compression or increase in the magnetic flux density on the arrival of the plasma. The magnetic probe measurements and the photographic study are shown. Author

N65-16899# General Motors Corp., Indianapolis, Ind. Engineering Dept.
MEASUREMENT OF FLUID PROPERTIES FOR MAGNETOPLASMADYNAMIC POWER GENERATORS Sixth Quarterly Technical Summary Report, 1 Aug.–31 Oct. 1964
R. T. Schneider 17 Nov. 1964 34 p refs
(Contract Nonr-4104(00); ARPA Order 420)
(Rept.-4037; AD-608638)

Minor design modifications were made in the closed loop system. The helium–cesium separation system was improved making possible larger recovery of cesium, and several helium-cesium runs were made. The seed injection system was also improved to obtain a controllable cesium mass flow without fluctuations. Voltage–current curves for different magnetic fields, when plotted directly with x-y recorders, gave straight lines. Spectroscopic observations detected a few impurities. A theory of the intercomponent thermal nonequilibrium was developed at small Hall coefficients. First numerical results for the buildup of the electron temperature nonequilibrium were obtained. The numerical value for the buildup length is in good agreement with the approximate formula obtained earlier. E.E.B.

N65-16935# United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
GRAZING INCIDENCE SPECTRA OF HIGHLY-IONIZED ATOMS FROM LABORATORY PLASMAS
B. C. Fawcett, A. H. Gabriel, B. B. Jones, and N. J. Peacock Apr. 1964 15 p refs Submitted for Publication
(CLM-P40)

Radiation from high temperature plasmas produced in the ZETA and Thetatron discharges has been studied down to the soft X-ray region using grazing incidence spectrographs. Two forms of instrument have been used; one designed for laboratory studies, and the other for solar observation from rockets.

Both use 600 line/mm ruled gratings at grazing angles between 1° and 4°. The resonance line of NeIX at 13.44 Å is the shortest wavelength so far observed. New spectra are reported from NeVII, NeVIII, AlX, AX, AXI, AXII, and XeIX. Author

N65-16959# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
TRANSMISSION AND REFLECTION OF ELECTROMAGNETIC WAVES BY A HOT PLASMA
E. C. Taylor 30 Nov. 1964 26 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-267; TDR-469(5220-10)-3; AD-455136)

The relativistic form of the Vlasov equation was used to solve the problem of transmission and reflection of normally incident electromagnetic waves. Transmission and reflection coefficients are derived for a plasma half-space and for a plasma slab, using the assumption that electrons are specularly reflected at the boundaries. These coefficients are functions of the ratio of the electron thermal speed to the vacuum speed of light, indicating that temperature dependence in these cases is a relativistic effect. Nevertheless, it is seen that the nonrelativistic limits of these coefficients differ from those obtained by using the cold-plasma equations because the transition to the zero-temperature limit has a nonuniform character. Author

N65-17002# Vitro Labs., West Orange, N. J.
ION DEBRIS SIMULATION Quarterly Progress Report, 1 Jul.–30 Sep. 1964
[1964] 56 p refs
(Contract DA-30-069-ORD-3616)
(VL-2267-13-0; AD-455655)

Major emphasis was given to plasma diagnostics, with a description of the material characteristics, the results obtained from plasma characterization studies, and the diagnostic techniques utilized. The material parameters necessary for making a judicious selection of the target material include the high-pressure equations of state and the coefficients associated with it. Plasma velocity measurements were made using double probe and streak photography techniques. A theoretical analysis of the operation of double probes to measure ion currents is given, and the results are presented. The time-of-flight measurement of plasma velocity, and the measurement of plasma density are discussed. E.E.B.

N65-17020# Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1964
A. H. Snell et al Feb. 1965 116 p refs
(Contract W-7405-ENG-26)
(ORNL-3760) OTS: $4.00

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7. PLASMA THEORY AND COMPUTATION T. K. Fowler et al p 69–76 refs
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10. FUSION CHAIN REACTIONS J. R. Mc Nally p 98–99 refs

N65-17034 United Kingdom Atomic Energy Authority, Culham (England). Culham Lab.
EQUILIBRIUM AND STABILITY OF PLASMA IN ARBITRARY MIRROR FIELDS
J. B. Taylor Jan. 1964 17 p refs Submitted for Publication
(CLM-P36)

An appropriate choice of variables can greatly simplify the discussion of equilibrium and stability of low-pressure plasma in arbitrary mirror fields. One specifies by α, β the line of force on which a particle is moving and also specifies its adiabatic invariants μ, J; the energy of the particle is then determined as a function $K(\mu,J,\alpha,\beta)$ which plays the role of a Hamiltonian. Any equilibrium distribution can then be written in the form $F\{\mu,J\ K(\alpha,\beta,\mu,J)\}$, and it is shown that a sufficient criterion for such distributions to be stable against interchanges is $\left(\frac{\partial F}{\partial K}\right)_{\mu,J} < 0$. Necessary and sufficient criteria are also derived. When approached in this way, the exact form of the field configuration only enters the problem through the determination of the function K, which may be easily calculated. In general a comprehensive view of plasma behavior, convenient for the discussion of equilibrium, confinement, and stability, can be obtained from the structure of the $K(\alpha,\beta,\mu,J) =$ constant contours. An example of the application of this approach to a Ioffe stabilized mirror is described, and confirms the existence of stable plasma equilibria in this field configuration. Author

N65-17041# Minnesota Univ., Minneapolis. Plasma Physics Lab.
STUDY IN COLLISION PROCESSES IN GASEOUS PLASMAS Semiannual Technical Report, Jan. 1964–Jul. 1964
H. J. Oskam, ed. Nov. 1964 18 p
(Contract Nonr-710(37); Grant NsF GP-559)
(SATR-2; AD-451910)

The feasibility of measuring the time dependence of the electron density during the afterglow period by the extraction period was investigated by using simple experimental tubes. Density measurements of various species of positive ions present in an active or decaying plasma were made by using a simultaneous light emission, light absorption, mass analysis tube, and a mass spectrometer of the quadrupole field type. The existence of the hybrid molecular ions $(NeAr)^+$ and $(NeKr)^+$ in plasmas was established. The number densities of the hybrid molecular ions decreased with increasing gas pressure, and a tentative theory explaining the pressure dependence of the member density is presented. G.G.

N65-17157# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RESEARCH ON RADIATION FROM ARC HEATED PLASMA Interim Technical Report, 1 Jun. 1961–1 Mar. 1964
J. C. Morris, G. R. Bach, and J. M. Yos Wright-Patterson AFB, Ohio, ARL, Oct. 1964 88 p refs
(Contract AF 33(616)-8390)
(ARL-64-180; AD-610633)

The spectral distribution of the continuum radiation of nitrogen and argon plasma was measured for temperatures ranging from 8000° to 13 000° K at atmospheric pressure. The wavelength interval, 2680 to 20 900 A, over which the nitrogen continuum was investigated, accounts for approximately 90% of the total energy radiated by the continuum. The spectral distribution of the continuum is integrated to obtain a measurement of the total continuum energy radiated from nitrogen. These data are compared with direct measurements of the total radiation and with a number of theoretical predictions. These comparisons indicate that atomic line radiation is not an important contributor to the total radiation for the conditions under investigation, and that another source of continuum radiation such as the negative nitrogen ion may be an important contributor in the visible region of the spectrum. Electrical and thermal conductivities of nitrogen and argon plasma were measured over the temperature range from 8000° to 13 000° K at atmospheric pressure. Author

N65-17159# Electro-Optical Systems, Inc., Pasadena, Calif.
BASIC RESEARCH ON GAS FLOWS THROUGH ELECTRIC ARCS: MEASUREMENT TECHNIQUES AND ANALYTICAL PROCEDURES Interim Technical Report
G. L. Marlotte and M. L. Dalton Wright-Patterson AFB, Ohio, ARL, Nov. 1964 80 p refs
(Contract AF 33(657)-7940)
(ARL-64-208; AD-610544)

Experimental and theoretical investigations dealing with interaction phenomena between gas flows and electric arcs in a Maecker-type, segmented, water-cooled arc column are reported. This report details or references the measurement techniques and procedures used for measuring the various parameters of the arc column, including the power radiated per unit length and the temperature distribution, and it presents experimental information including the results of downstream gas injection. The analytical procedures used to solve the direct arc column problem (finding the arc-flow parameters, given the plasma properties) and the inverse arc column problem (finding the plasma properties, given the arc-flow parameters) for the asymptotic or fully developed region, are presented. Author

N65-17160# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
EXPERIMENTAL AND ANALYTICAL STUDY OF THE FUNDAMENTAL INTERACTION AND ENERGY EXCHANGE PROCESSES BETWEEN ELECTRIC ARC DISCHARGES AND CROSS-FLOW FIELDS OF PRE-IONIZED GASES WITH AND WITHOUT THE PRESENCE OF TRANSVERSE MAGNETIC FIELDS Final Report, 30 Jun. 1963–30 Jun. 1964
A. C. Malliaris Wright-Patterson AFB, Ohio, ARL, Dec. 1964 126 p refs
(Contract AF 33(657)-11310)
(ARL-64-216; AD-610031)

The experimental work includes high speed photography and measurements of electrical characteristics, heat transfer to the electrodes, as well as radiation emitted by the discharge. A wide variety of data is presented in graphs and tables. The data are correlated in terms of an approximate theory which is developed. The comparison of the experiment with the theory is partially satisfactory. Some conclusions of practical interest are the following: (1) The electrical discharge under consideration has arc-like characteristics. (2) The column occupies a small fraction of the cross-sectional area in the flow. (3) The fraction of the input power used for acceleration is small. (4) The predominant mode of energy transport from the discharge is convection. (5) Conduction and radiation are negligible. (6) The input power increases in the presence of a magnetic field, but the electrical conductivity is independent of the magnetic field up to 5000 gauss. Author

N65-17175# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIAL DISTRIBUTION OF CHARGED PARTICLE CONCENTRATION IN A MAGNETIC ION SOURCE
M. D. Gabovich and Yu. B. Yermolovich 14 Dec. 1964 13 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 2, no. 2, 1957 p 165–173
(FTD-TT-64-442/1+2; AD-610277)

The results of experiments on a magnetic ion source show that an increased magnetic field is accompanied by a main discharge column, the radius of which approaches the cathode radius. This column is a plasma pierced by the fast primary electrons. The law of the radial discharge distribution inside the column differs from that outside the column if the magnetic field is large enough. An equation was obtained for radial distribution of the charged particles concentration. It is based on the assumption that ionization is produced mainly by the fast primary electrons, but that the neutralization of the positive space charge takes place chiefly because of the slow electrons. With some simplification, the radial distribution of the charged-particle concentration inside the column can be expressed by an equation whose validity within the column is confirmed by experiment. D.E.W.

N65-17191# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE EFFECT OF A TRANSVERSE MAGNETIC FIELD ON RESISTANCE OF PLATE
A. Tsinober and E. Shcherbinin 21 Dec. 1964 9 p refs Transl. into ENGLISH from Izv. an Latviyskoy SSR, no. 6, 1963 p 43–48
(FTD-TT-64-803/1+2; AD-610346)

Experimental investigation was made of the effect of a transverse magnetic field on the resistance of a plate in laminar flow. The effect of the magnetic field on plate resistance was represented by a curve which showed the dependence of the relative resistance coefficient upon the Stewart number. Also, approximate calculation of the boundary layer on a plate, in the presence of a magnetic field transverse to the plate in laminar flow, gave a similar curve. The resistance curve, from the approximate calculation, has the same form as the experimental curve. The experimental curve is a little higher than the calculated one. The difference is due to the fact that the calculation is made without consideration of the end effects of the plate. E.E.B.

N65-17255*# California Univ., Berkeley. Space Sciences Lab.
INVESTIGATION OF KILOVOLT ION SPUTTERING Quarterly Progress Report
Harold P. Smith, Jr. and F. C. Hurlbut 31 Jan. 1965 30 p refs
(Contract NAS3-5743)
(NASA-CR-54129, Ser. 6, Issue 4) OTS: HC $2.00/MF $0.50

Final measurements were made to assure that the cesium ion beam is focused and transported from the surface contact source to the target through a series of electrostatic lenses without significant electron contamination or recombination. The problem of focusing and transport of heavy ion beams in the KeV energy range received additional study due to anticipated problems with the mercury ion beam which requires magnetic analysis. An adjustable lens system was constructed and tested to study this problem, and an IBM 7094 computer program, adapted to the apparatus, is being used in conjunction with the experimental study. Various components

of a suitable time-of-flight apparatus were investigated. The ultra-high-vacuum chamber was able to attain pressures in the low 10^{-10} torr range, while a new ion source was operated at greater than 10 μA. It was found that a small deflection chamber can successfully deflect the beam. Author

N65-17275*# Naval Research Lab., Washington, D. C. Radiation Div.
RADIATION LOSSES FROM HIGH-TEMPERATURE GAS DISCHARGES
Alan C. Kolb [1963] 26 p 14 refs Presented at the Symp. on Quant. Spectroscopy and Appl. in Space Sci., Calif. Inst. of Tech., Pasadena, 20–22 Mar. 1963
(NASA Order R-9)
(NASA-CR-50352) OTS: HC $2.00/MF $0.50

Numerical calculations are given for the impurity-radiation losses and cooling of a deuterium plasma produced by high-current electrodeless discharges in low-inductance, single-turn coils (θ-pinches). Electron temperatures in $10^{6\circ}$ K range have been measured in a number of laboratories from the soft X-ray radiative recombination-bremsstrahlung continuum emitted by such plasmas, and it is possible to make a semiquantitative comparison of the theory with available experimental data. The calculations given are of a preliminary nature and only serve to indicate the influence of radiative losses on the hydromagnetic behavior of plasma. I.v.L.

N65-17368# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ACCELERATION OF PLASMOIDS IN COAXIAL SOURCE
A. M. Kovalev 2 Mar. 1964 16 p refs Transl. into ENGLISH from the publ. "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sintez" Kiev, Ukr. Akad. Nauk p 231–237
(FTD-MT-64-31; AD-602573)

The investigation of the work on coaxial sources led to the following conclusions when secondary breakdowns of the coaxial were absent: (1) With an increase of the capacity of the capacitor battery of source, the speed of plasmoids increases, but the growth itself strongly decreases. (2) At present, there are sources with such large values of the parameter q, that the corrections Δi, $\Delta\gamma$, and $\Delta\gamma'$ can be disregarded. (3) For such sources, the speed of plasmoids of constant mass is proportional to $\sqrt[4]{V_0^2/m}$, and the speed of plasmoids of variable mass is proportional to $\sqrt[4]{V_0^2/m_0}$. (4) In coaxial sources with identical parameters, the acceleration of plasmoids of constant mass is approximately twice as effective (with respect to speed) as the acceleration of plasmoids of variable mass. Author

N65-17382# Paris Univ., Orsay (France). Laboratoire des Hautes Energies
STUDY OF A PLASMA OF ARGON AND ARGON–HYDROGEN MIXTURE Technical Note No. 2
A. Constantin, J. Godart, J. J. Hamm, and R. Rioux [1964] 23 p refs
(Contract AF 61(052)-727)
(AFCRL-64-745; AD-606649)

In this report the relative importances of elastic, inelastic, e–i, and o–e collisions are investigated for plasmas of argon and argon–hydrogen mixture. A differential equation, neglecting propagation effect, is given, allowing the calculation of the conductivity of a plasma when the isotropic part of the distribution function is known. The computation of the stationary conductivity of an argon plasma with small amounts of molecular hydrogen is made for a Maxwellian distribution function. Author

N65-17433# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
A METHOD FOR DETERMINING PROFILES OF RADIAL ELECTRON DENSITY AND COLLISION FREQUENCY IN THE WAKES OF HYPERSONIC PROJECTILES USING TRANSVERSE MICROWAVE PROBES
James Mc Leod and Srbislay Zivanovic Nov. 1964 57 p refs (Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)
(TR-64-02M; AD-456958)

A method is presented for converting the raw data created daily by two six-channel microwave probes into more conventional charts of electron density and collision frequency. Also given is a method for accurate determination of the position and velocity of hypersonic projectiles from the time–distance data. A brief discussion of the actual computer program for data reduction, which incorporates both methods, is contained in the appendixes. Author

N65-17498# Sydney Univ. (Australia). Wills Plasma Physics Dept.
DENSITY PROFILES OF DECAYING HYDROGEN AND HELIUM PLASMAS
C. A. Hooker, L. C. Robinson and L. E. Sharp Aug. 1964 14 p refs
(ER-10)

The distribution of plasma density in a cylindrical metal vessel has been measured by the method of modulated dipole microwave interferometry. The resulting density profiles are presented and supported by framing camera photographs and measurements based on the Stark broadening of spectral lines. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-16408# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
ETCHING AND CRYSTAL GROWTH IN GaAs-Sn SYSTEM
M. F. Millea and W. R. Wilcox 30 Dec. 1964 14 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-263; TDR-469(9230-03)-1; AD-455135)

The morphology of the dissolution of GaAs by Sn and its subsequent regrowth has been studied. The macroscopic etching and regrowth features are related and seem to be affected primarily by the surface energy vs orientation relationship. The dissolution rate of the As [111] is greater than that of the Ga[111]. The rate of regrowth perpendicular to the Ga [111] face is greater than the rate perpendicular to the As [111]. The presence of the As_4 molecule in solution is believed to be responsible for the different dissolution and regrowth rates of the As [111] and Ga [111]. Author

N65-16413# Boeing Scientific Research Lab., Seattle, Wash. Solid State Physics Lab.
SOME EFFECTS OF ANHARMONIC POTENTIAL ON LATTICE VIBRATIONS
Kwong-tin Tang Aug. 1963 16 p refs
(DI-82-0289)

In lattice dynamics an anharmonic potential causes the force constants to be temperature dependent. A simple but significant coordinate transformation shows the explicit relationship between them. Such a relationship is seen to be in agreement with actual measurement. For a linear monatomic

chain with the nearest neighbor interaction and an anharmonic potential, a calculation of the frequency is carried out by a perturbation method. The result is similar to that of the next nearest neighbor interaction. Author

N65-16417# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
SUPERCONDUCTIVITY IN SINGLE CRYSTALS OF COLUMBIUM AND COLUMBIUM-ZIRCONIUM ALLOYS Final Report, Dec. 1, 1961–Nov. 30, 1964
C. S. Tedmon, Jr., L. C. Skinner, II, R. M. Rose, and J. Wulff 30 Nov. 1964 108 p refs
(Grant DA-ARO(D)-31-124-G478)
(AROD-3473-2; AD-455346)

A discussion of hard superconductivity and the various filamentary models is presented with consideration of the sensitivity of niobium to cold work, impurities, and substructure. Niobium single crystals, with axial orientations of <100>, <110>, <111>, and <112> were grown in high vacuum. Transverse-field critical currents were measured with the currents and fields aligned with principal crystallographic axes. A large, reproducible anisotropy was found when the current flowed down the <100> axis with regard to the direction of the transverse field. The <111> axis showed little or no anistropy in this connection. The Mendelssohn hard-mesh filamentary model is found to be inapplicable to the data. However, the results can be qualitatively accounted for by the flux structure predicted by Abrikosov and Goodman. The influences, dislocations, and dislocation substructure are cited and corroborative evidence presented. Author

N65-16442# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institüt für Energiewandlung und Elektrische Antriebe
NONTHERMIC PLASMA AND ELECTRIC CONDUCTIVITY [NICHTTHERMISCHES PLASMA UND ELEKTRISCHE LEITFAHIGKEIT]
P. Wahle Aug. 1964 54 p refs In GERMAN
(DLR-FB-64-13; DVL-304) Available from ZLDI, Munich: 13 DM

Intensive tests were performed on plasmas and their behavior in electric and magnetic fields. These tests aim at the technical realization of transforming kinetic energy directly into electric energy, and vice versa, with an acceptable degree of efficiency. In the first case, this transformation takes place in magnetohydrodynamic generators; in the second case, in plasma accelerators. High conductivity on the plasma is essential for a good efficiency. In thermal plasma, this requirement coincides with a high plasma temperature which of course constitutes a high load on the materials. To avoid this thermal stress, the high conductivity of nonthermal plasmas with high electron temperature but low gas temperatures is utilized. This report gives a summary on nonthermal plasma; and the plasma conductivity in electric and magnetic fields is investigated. Author

N65-16444# Martin Co., Baltimore, Md. Nuclear Div.
A STUDY PROGRAM ON CESIUM VAPOR FILLED THERMIONIC CONVERTERS HAVING HIGH VACUUM WORK FUNCTION EMITTER MATERIALS Yearly Summary Report, 1 Nov. 1963–31 Oct. 1964
A. J. Kennedy 31 Oct. 1964 86 p refs
(Contract Nonr-3639(00))
(MND-3177; AD-608554) OTS: $3.00

Ruthenium, a material having relatively low neutron absorption cross section, was investigated both as an emitter and collector in a thermionic converter. Both hot-pressed and plasma-sprayed ruthenium emitters were found to behave like high-vacuum work function materials (i.e., display high output current densities at relatively low cesium pressures). Significant differences were noted, however, in the performance of the two ruthenium emitters prepared by the different processes. The performance of the ruthenium emitters is compared to that of iridium and rhenium emitters. Generally, the ruthenium data show a higher output power density, particularly at relatively wide (10 to 30 mil) interelectrode gaps. The ruthenium plasma-sprayed collector assumes its minimum value at a temperature which is lower than that for a molybdenum collector by approximately 100° K. The value of collector work function at optimum is indicated to be approximately equal for ruthenium and molybdenum. Author

N65-16450*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDY OF IRRADIATION-INDUCED ACTIVE SITES ON MAGNESIUM OXIDE WITH THE USE OF ELECTRON PARAMAGNETIC RESONANCE
Jack H. Lunsford Washington, NASA, Feb. 1965 10 p refs Presented at the Meeting of Am. Inst. of Chem. Engr., Dec. 1963, Houston, Tex. Also Published in the J. of Phys. Chem., v. 68, Aug. 1964 p 2312–2316
(NASA-TN-D-2668)

The ultraviolet-irradiation-induced catalytic activity of magnesium oxide and the electron paramagnetic resonance spectra on the same sample were studied. The data show that a correlation exists between the V_1 center concentration and the enhanced catalytic activity for the hydrogen–deuterium exchange reaction, $H_2 + D_2 \rightleftarrows 2HD$. (The V_1 center is defined as a hole trapped at an anion adjacent to a cation vacancy.) Samples were subjected to degassing at 290° and 500° C, to thermal decay at −79°, 0°, and 30° C, to 2537 Å ultraviolet light as a function of time, and to several different wavelengths of ultraviolet light. It is concluded that either a V_1-type center existing on the surface is an active site for the exchange reaction or the V_1 center formation is an integral step in the formation of the active site; i.e., it is a hole trap that prevents recombination. Author

N65-16453# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA (NEWS OF ACADEMY OF SCIENCES USSR: PHYSICS SERIES), VOLUME 28, NO. 9, SEPTEMBER 1964
27 Jan. 1965 51 p refs Transl. into ENGLISH
(JPRS-28487; TT-65-30208) OTS: $2.00

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3. THERMOELECTRON EMISSION OF CERTAIN MATERIALS IN CESIUM VAPORS S. Ya. Lebedev and Yu. Ya. Stavisskiy p 14–20 refs (See N65-16456 07-26)

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9. DETERMINATION OF THERMO-EMISSION CONSTANTS OF METALLIC-FILM CATHODES IN CONVERTERS V. D. Bondarenko, Yu. K. Gus'kov, and V. P. Pashchenko p 44–47 refs (See N65-16462 07-26)

N65-16454 Joint Publications Research Service, Washington, D. C.

SOME FEATURES OF SECONDARY ION EMISSION DURING BOMBARDMENT OF METALS BY LOW-ENERGY IONS

U. A. Arifov, D. D. Gruich, and L. Yu. Chastukhina *In its* Transl. from Izv. Akad. Nauk SSSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 1–9 refs (See N65-16453 07-26) OTS: $2.00

After an experimental investigation and an examination of previously published literature, it is concluded that the mechanism of formation of the group of secondary ions differs from elastic scattering. It is supposed that the primary ions stick to the metal crystal lattice when they strike it, and transfer their energy to it. The lattice transfers some of this energy to other ions, previously adsorbed on the lattice, and then emits them. D.E.W.

N65-16455 Joint Publications Research Service, Washington, D. C.

CATHODE SPUTTERING DURING BOMBARDMENT BY ACCELERATED IONS OF CESIUM

S. Ya. Lebedev, Yu. Ya. Stavisskiy and Yu. V. Shut'ko *In its* Transl. from Izv. Akad. Nauk SSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 10–13 refs (See N65-16453 07-26) OTS: $2.00

The relationship between the coefficient of cathode sputtering for various metals over a range of temperatures and the energy of bombarding cesium ions was studied. The metals included nickel, titanium, niobium, platinum, carbon, molybdenum, rhenium, tungsten, tantalum, iron, and a stainless steel. The cesium ions had energies between 2 and 10 keV, and the metals were maintained at temperatures between 700° and 1100° C. The behavior of the sputtering coefficient with respect to ion energy, and the increase of sputtering with increasing surface temperature are shown in graphs. D.E.W.

N65-16456 Joint Publications Research Service, Washington, D. C.

THERMOELECTRON EMISSION OF CERTAIN MATERIALS IN CESIUM VAPORS

S. Ya. Lebedev and Yu. Ya. Stavisskiy *In its* Transl. from Izv. Akad. Nauk SSSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1965 27 Jan. 1965 p 14–20 refs (See N65-16453 07-26) OTS: $2.00

The thermoemission properties of several materials in cesium vapor were investigated. Materials studied include tungsten, molybdenum, titanium, tantalum, carbon, rhenium, niobium, nickel, hafnium, zirconium, and a stainless steel. The cathode investigated was a thin-walled tube heated by electric current. The temperature was measured with a PtRh–Pt thermocouple inserted into the tube. A three-sectional cylinder served as the anode. Curves of thermoemission current versus surface temperature at various vapor pressures are given. D.E.W.

N65-16457 Joint Publications Research Service, Washington, D. C.

SURFACE IONIZATION OF CESIUM DURING THE DIFFUSION OF ITS VAPORS THROUGH POROUS MOLYBDENUM, TUNGSTEN, NICKEL AND RHENIUM BARRIERS

S. Ya. Lebedev and Yu. Ya. Stavisskiy *In its* Transl. from Izv. Akad. Nauk SSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 21–24 refs (See N65-16453 07-26) OTS: $2.00

The experimental apparatus for studying the surface ionization at porous barriers is described. This equipment was used to study the relationship between ion current density and surface temperature at various rates of cesium-vapor consumption. Temperature dependence curves are shown for molybdenum, tungsten, nickel, and rhenium. Author

N65-16458 Joint Publications Research Service, Washington, D. C.

EFFECT OF A LONGITUDINAL MAGNETIC FIELD ON A LOW-VOLTAGE ARC.

Yu. K. Gus'kov, M. A. Lebedev, and I. P. Stakhanov *In its* Transl. from Izv. Akad. Nauk SSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 25–29 refs (See N65-16453 07-26) OTS: $2.00

Results of a study of the effects of a longitudinal magnetic field on a low-voltage arc in cesium vapor are presented. Tests were performed in a discharge chamber, which was installed in a two-section thermostat made of nonmagnetic material with a bifilarly wound nichrome heater. The magnetic field intensity H could be varied from zero to 430 Oe by changing the current from zero to 30 A. The effect of H on the discharge current is displayed in a graph, and another graph shows that at low pressures, and when $l_e >> d$, current increases with the increasing magnetic field and reaches a maximum at $H_{crit} = 320$ Oe. It is shown that I_H depends on H at various cathode temperatures. With increasing $T_{cathode}$ the maximum of I_H/I_0 increases in magnitude and shifts toward higher magnetic field intensities. That I_H depends on H at various values of I_0 is also shown. It is concluded from the data that the effect of the magnetic field becomes stronger as I_0 decreases. D.E.W.

N65-16459 Joint Publications Research Service, Washington, D. C.

APPLICATION OF THE GRAD METHOD IN THE DESIGN OF A THERMOELECTRON ENERGY CONVERTER

S. A. Mayev and I. P. Stakhanov *In its* Transl. from Izv. Akad. Nauk SSSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 30–32 refs (See N65-16453 07-26) OTS: $2.00

The Grad method consists essentially in finding the solution of a kinetic equation in the form of a series of orthogonal vectorial velocity polynomials that involve symmetric Hermit polynomials and a Maxwell function. The simplest series expansion based on this method, the coefficients of which (expansion) depend only on flow of the medium, heat flow, and temperature, was used for study of the processes in a thermoelectric converter. An equation is presented that can be used for deriving the relationship between the saturation current and the ratio of free path length to system dimensions under given conditions. D.E.W.

N65-16460 Joint Publications Research Service, Washington, D. C.
STUDY OF THE OPERATION OF A THERMOELECTRON CONVERTER WITH VARIOUS METALLIC-FILM CATHODES
Yu. K. Gus'kov, V. P. Pashchenko, and Ye. Ye. Sibir *In its* Transl. from Izv. Akad. Nauk SSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 33-38 refs (See N65-16453 07-26) OTS: $2.00

Thermoelectric converters with cathodes of niobium, molybdenum, tungsten, and rhenium, in diffusion and other modes, were studied. Graphs are given of the relationship between the short-circuit current and the cathode temperature at different pressures of cesium vapor, for niobium and rhenium cathodes. These graphs show that, as the cathode temperature is raised, the short-circuit current first increases, then levels off or in some cases decreases, and finally increases again, in steps. Volt-ampere characteristics were determined at different portions of the curves. Up to the part of the temperature curve where it begins to rise in steps, the results of these last measurements agreed fairly well with the diffusion theory of a thermoelectric converter. D.E.W.

N65-16461 Joint Publications Research Service, Washington, D. C.
EFFECT OF THE CATHODE WORK FUNCTION ON THE OPERATION OF A THERMOELECTRON CONVERTER IN A DIFFUSION SYSTEM
V. P. Karmazin, I. I. Kasikov, and I. P. Stakhanov *In its* Transl. from Izv. Akad. Nauk SSSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 39-43 refs (See N65-16453 07-26) OTS: $2.00

An analysis of experimental data led to the conclusion that thermodynamic equilibrium at the cathode under short circuit conditions is attained over a wide range of temperatures. However, at higher temperatures the current increases at a slower rate, as predicted by the theory of the equilibrium state. The results of calculations for the cooling of the cathode by the electron current are given. This measure of the electron cooling is used in estimating the converter efficiency. D.E.W.

N65-16462 Joint Publications Research Research Service, Washington, D. C.
DETERMINATION OF THERMO-EMISSION CONSTANTS OF METALLIC-FILM CATHODES IN CONVERTERS
V. D. Bondarenko, Yu. K. Gus'kov, and V. P. Pashchenko *In its* Transl. from Izv. Akad. Nauk SSR, Ser. Fiz. (News of Acad. of Sci. USSR: Phys. Ser.) Vol. 28, No. 9, Sep. 1964 27 Jan. 1965 p 44-47 refs (See N65-16453 07-26) OTS: $2.00

Two methods are discussed for the measurement of thermoemission constants. One is a variation of the contact-potential difference method, and is based on the measurement of the shift in the volt-ampere characteristic that results from a change in the anode work function with temperature. The second method consists in the determination of the Richardson current after the current through the converter has deviated from its equilibrium value in an overcompensated system. A relation is then given between the converter current and the Richardson current, which is valid for moderate values of cathode fall. These two methods can be applied to the measurement of work functions for metallic-film cathodes at higher pressures. By combining the methods, it is possible to determine the work function as well as the Richardson constant. D.E.W.

N65-16496*# California Univ., Los Angeles.
SUPERCONDUCTIVITY IN THE ARTIFICIAL METALS: METALLIC INDIUM ANTIMONIDE, THE INDIUM ANTIMONIDE-TIN ALLOYS, AND METALLIC INDIUM TELLURIDE
B. R. Tittmann, A. J. Darnell, H. E. Bommel, and W. F. Libby [1964] 10 p refs
(Grants NsG-237-62; AF-AFOSR-245-64)
(NASA-CR-56040) OTS: HC $1.00/MF $0.50

Superconductivity was observed in metallic indium antimonide, the alloys of indium antimonide with tin, and in indium telluride. The compounds and alloys were prepared and stabilized at atmospheric pressure. Superconducting transition temperatures and critical magnetic fields were obtained by the eddy current decay method used in measuring resistivities. Author

N65-16518# IIT Research Inst., Chicago, Ill. Technology Center
EXCESS NOISE IN SEMICONDUCTORS Annual Summary Report, 15 Nov. 1963-14 Nov. 1964
James J. Brophy 9 Nov. 1964 18 p refs
(Contract Nonr-1800(00))
(ASR-9; AD-608509) OTS: $2.00

Both the forward-current noise spectrum and the optical emission noise spectrum of a GaAs luminescent diode exhibit characteristic relaxation times of 13 and 2.3 msec. Presumably, these are related to injected carrier transitions associated with photon emission. In further confirmation of this interpretation is the fact that the low frequency noise level of both spectra is several orders of magnitude greater than shot noise associated with the junction current. The reverse-current noise spectrum is simple $1/f$ noise over the frequency interval from 10 to 10000 cps. No change in character of the spectrum is observed under optical illumination of the junction, so that the effect is attributed to reverse leakage currents. To define more clearly the optical emission noise spectrum, it is necessary to reduce the optical detector noise level. Experiments are underway cross-correlating the outputs of two photodetectors, which reduces the influence of internal detector noise. Author

N65-16558# Michigan Univ., Ann Arbor. Electron Physics Lab.
SOLID-STATE MICROWAVE RESEARCH Interim Scientific Report No. 5, Oct. 1, 1964-Jan. 1, 1965
D. C. Hanson, J. E. King, J. E. Rowe, and C. Yeh Jan. 1965 36 p refs
(Contract AF 33(657)-11587)
(Rept.-06031-5-S; AD-456009)

The investigation of electromagnetic wave absorption by vanadium-doped cadmium sulfide was continued using both a simple video detection scheme and a more sophisticated balanced-bridge spectrometer. The sensitivity of the system is such that the absorption line for one grain of DPPH at liquid helium temperature could be observed. No absorption spectra for Va:CdS have been observed. Recent experiments on both n- and p-type GaAs are outlined in detail and it is shown that the detailed characteristics of the radiation phenomena are quite dependent on the nature of the ohmic contacts. Results on a study of crystal alloying techniques are given including results of microwave impedance measurements as a function of bias voltage. Thin-film CdS transducers for acoustic-wave amplifiers are being studied using a microwave reflection setup to determine the coupling loss and relative excitation of acoustic phonons in piezoelectric materials. Author

N65-16561# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TUNNEL EFFECTS IN SOLID BODIES

Tadeusz Figielski 7 Dec. 1964 15 p refs Transl. into ENGLISH from Postepy Fiz. (Poland), v. 14, no. 4, 1963 p 455–466
(FTD-TT-64-426/1+2; AD-455368)

The conduction mechanism of a semiconductive diode with a monocrystal line arrangement is described and presented schematically. The Zehner tunnel effect of exciting electrons directly from the valence band to the conduction band under high electric fields is presented in the case of germanium, where visible current-produced tunneling of electrons appeared in the fields of the order of 5×10^5 v/cm. The current–voltage characteristics of Esaki's germanium diode are described, and the appearance of considerable superfluous currents at not too high polarization voltages is observed. The negative resistance area in the Esaki diode permits its application for generation and amplification of electrical signals. The structure of the Esaki diodes indicate a clear modification of the energy bands that are caused by atoms of admixtures. G.G.

N65-16566# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
MODULATION OF THE REFLECTIVITY OF SEMICONDUCTORS
M. Birnbaum 4 Dec. 1964 13 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-253; TDR-469(9230-02)-1; AD-455989)

Large increases in the reflectivity of GaAs, Ge, Si, and InSb were observed in the reflection of intense beams of ruby laser light from polished surfaces of these semiconductors. The reflectivity of focused beams incident at the pseudo-Brewster angle is measured as a function of the incident light intensity. Absorption of the laser light in the surface layer produces an electron-hole plasma (density approximately 10^{21} cm^{-3} at the highest power levels) that imparts metallic type reflectivity to the semiconductor. At the highest power levels all of the semiconductors were damaged, although in the case of Si the damage was very slight. These large increases in reflectivity indicate a number of applications in the modulation and control of lasers. Author

N65-16584*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN INVESTIGATION OF THE VANADIUM-GALLIUM SYSTEM BETWEEN 50 AND 100 ATOMIC PERCENT VANADIUM
John J. Fischer and Hubert B. Probst Washington, NASA, Feb. 1965 10 p refs
(NASA-TN-D-2647) OTS: HC $1.00/MF $0.50

The vanadium–gallium system within the compositional range from 50 to 100 at% V was investigated. Samples prepared by melting were studied by X-ray diffraction and metallographic techniques after slow cooling from 1100° C. The superconducting V_3Ga phase was found to exist over a very limited compositional range. At room temperature, V_3Ga exists in equilibrium with either V_6Ga_5 (for compositions containing less than 75 at% V), or a Ga saturated V solid solution (for compositions containing more than 75 at% V). Both V_6Ga_5 and the V solid solution are nonsuperconducting at 4.2° K. The microstructures of samples near 75 at% V(V_3Ga) were essentially identical whether compositions were slightly hypostoichiometric or slightly hyperstoichiometric. Author

N65-16704# Hahn-Meitner-Institut für Kernforschung, Berlin (West Germany).
THE KINETICS OF RARE-GAS DIFFUSION IN SOLIDS. TABLES AND GRAPHS FOR THE EVALUATION OF POST-ACTIVATION DIFFUSION EXPERIMENTS (RARE-GAS DIFFUSION IN SOLIDS 10)
T. Lagerwall and K. E. Zimen Brussels, EURATOM, Aug. 1964 38 p refs
(Contracts EURATOM-064-61-8-RDD; EURATOM-094-62-9-RDD)
(EUR-1372.e; EURAEC-772) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 60 Belg. Fr.

The exact solution of the equation for the kinetics of diffusion of rare-gas atoms out of a crystal, where they were created by irradiation and nuclear reaction, was calculated with a digital computer in spherical, cylindrical, and rectangular symmetries for different crystal parameters. The results are presented in graphs and tables which permit a general and direct evaluation of postactivation-diffusion experiments made with crystals of spherical form, and of any cylindrical or rectangular form. Author

N65-16762# Carnegie Inst. of Tech., Pittsburgh, Pa.
SURFACE FIELD EFFECT DEVICE STUDIES FOR HIGH RESISTIVITY GALLIUM ARSENIDE. PART I: SURFACE STATES ON GALLIUM ARSENIDE
Earl J. Charlson Nov. 1963 29 p refs
(Contract Nonr-760(09))
(AD-603751)

Surface states on a GaAs (110) surface were studied by capacitance measurements on an MIS (metal-insulator-semiconductor) diode. In particular, the small signal high frequency differential capacitance of an Al-evaporated SiO-GaAs diode as a function of dc bias is presented. This curve is then compared to the theoretical variation of the ideal MIS diode (without surface states) and the surface state density as a function of position in the bandgap is determined. Results indicate a distribution of states very similar to that determined for the Al-thermally grown SiO_2-Si system except for a factor of 10 less states on the GaAs. Author

N65-16773# Illinois Univ., Urbana.
PHYSICS OF THE SOLID STATE. THE MASS SPECTROGRAPHIC ANALYSIS OF POTASSIUM CHLORIDE CRYSTALS
Robert J. Maurer and Hiroshi Ohkura Sep. 1964 19 p refs
(Contract Nonr-1834(19))
(TR-8; AD-608673)

A mass spectrographic technique for the impurity analysis of potassium chloride by the high frequency spark source technique was developed. The method should be suitable for the analysis of other alkali halide crystals, and similar insulating materials. Preliminary results are presented for a crystals of potassium chloride, zone refined crystals, and a crystal which was treated to eliminate bromine. Because of the low ionization potential of potassium, and the use of the ^{41}K line as an internal standard, considerable uncertainty is associated with the absolute impurity concentrations that are reported. The relative impurity concentrations of the crystals are believed however, to be reliable. Author

N65-16799# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED RADIATION DETECTOR MADE OF GOLD-DOPED GERMANIUM
Z. Majewski, A. Ambroziak, and J. Swiderski 14 Nov. 1964 7 p Transl. into ENGLISH from Przeglad Elektroniki (Poland), v. 4, no. 4, 1963 p 251–254
(FTD-TT-64-80/1+2; AD-452368)

The photoelectric conductivity of gold-doped germanium infrared detectors depends on (1) the high purity grade of germanium; (2) the introduction of highly pure gold into this germanium; and (3) the introduction of other pure admixtures. Satisfactory results were obtained by gold diffusion into the pure germanium monocrystals. G.G.

N65-16803 Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics
THERMODYNAMICS AND KINETICS OF FORMATION OF THE GLASS STATE AND INITIAL DEVITRIFICATION
David Turnbull 25 Sep. 1964 17 p refs
(Contract Nonr-1866(50))
(TR-2; AD-608772)

A survey is made of conditions that determine whether liquids transform into a solid by the discontinuous process of crystallization or by a continuous transition leading to the formation of a metastable amorphous solid or glass. Several models for the transition from undercooled liquid to glass imply that the glass transition should be a universal characteristic of the liquid state and that there is a basic discontinuity, both structural and thermodynamic, between the amorphous and the crystalline states. The transition from either liquid or glass to the crystal must occur by nucleation and growth, and the interfacial tension between the amorphous and crystalline states is relatively large. Models for estimating this tension are discussed. The conditions which must be met by the crystallization kinetic constants for crystallization to be bypassed and for glass to form are surveyed. The effect of molecular constitution on glass formation is also considered. R.L.K.

N65-16821# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON DIELECTRICS FOR MICROWAVE ELECTRON DEVICES Final Report, 1 Jul. 1962–30 Sep. 1964
L. Feinstein, J. Bordeaux, D. Peters, and C. Peltzer Nov. 1964 113 p refs
(Contract DA-36-039-SC-90856; Proj. Defender)
(Rept.-9; AD-455565)

The transport and breakdown properties of aluminum oxide, and of methods of growth of this dielectric from the vapor phase in an evacuated system, were studied. An ultra-high-vacuum system capable of reaching pressure of 10^{-9}–10^{-10} torr was completed, and Alpha aluminum oxide films were grown by thermal evaporation in the system. Growth of aluminum oxide films, ranging in thickness from 1000 Å to 5000 Å by five different methods, was achieved in an interim vacuum system operating in the 10^{-6} –10^{-7} torr range. Data from experiments on transport in single crystal sapphire indicate that electron or hole conduction is primarily due to the effect of impurities of defects and, therefore, indicates either an impurity band or hopping process, or a polaron conduction mechanism. The data from electron bombardment and breakdown studies indicate that particle bombardment, in addition to creating defects if particle energy is sufficiently high, can also lead to formation of separated charge regions in the material. The study on the effect of gas ionization in alumina ceramics was completed. Author

N65-16846 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE HARTREE-FOCK EQUATIONS FOR NON-METALLIC CRYSTALS
M. I. Petrashen', N. N. Kristofel', and I. V. Abarenkov *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 1–15 refs (See N65-16845 07-34)

It is shown that all results of the one-electron zone theory concerning the structure of spectra of a crystal can be obtained from the examination of the system of Hartree–Fock equations. This system should be written in the form which takes into account the symmetry of the crystal and allows its physical interpretation. Author

N65-16848 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC SUSCEPTIBILITY OF A TWO-DIMENSIONAL ANISOTROPIC HARMONIC OSCILLATOR
T. K. Rebane *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 27–30 ref (See N65-16845 07-34)

An accurate method is given for calculating the magnetic susceptibility of a simple nonaxisymmetric system. E.P.V.

N65-16849 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STRUCTURE OF BAND EDGE ABSORPTION IN CUPRIT
A. S. Kondrat'yev and P. P. Pavinskiy *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 31–44 refs (See N65-16845 07-34)

It is shown that the main features of that part of the absorption band which is contiguous to the exciton line $n = 1$ in cuprit may be interpreted theoretically as being due to the additional phonon excitation in the lattice. The participation of the dipole and of the quadrupole transitions in the band formation is discussed. Author

N65-16851 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABSORPTION, LUMINESCENCE AND PHOTOCONDUCTIVITY OF POLYCRYSTALLINE FILMS AgI IN THE ABSORPTION EDGE AT LOW TEMPERATURES
K. F. Lider and B. V. Novikov *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 55–64 refs (See N65-16845 07-34)

The absorption spectrum of two polymorphous varieties (β- and γ-modifications) of polycrystalline films of AgI at 77° and 4° K was investigated. A strong absorption doublet with wavelengths 4229 and 4195 Å was discovered at 4° K in the γ-modification, and the absorption bands 4155 and 4118 Å in the β-modification. These bands were interpreted as exciton spectrum. The absorption lines in both modifications would correspond to the minimum of the photocurrent on the spectral curves of photoconductivity at 77° K. A resonance group of lines was precisely outlined in the luminescence spectrum β-type AgI at 4° K. There is also a large group (about 25 lines) of very narrow radiation lines at the absorption edge in the spectral interval 4227 to 4415 Å. Part of them may be interpreted as a combination of resonance electronic transitions with the optical phonon, and the other part may be explained by means of transitions to a split valence band. Author

N65-16854 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE THERMODYNAMICS OF SURFACE PHENOMENA IN A MONOCRYSTAL. II: FUNDAMENTAL EQUATIONS AND MEAN SURFACE TENSION OF THE MONOCRYSTAL
A. I. Rusanov *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 95–106 refs (See N65-16845 07-34)

On the basis of consideration of the dependence of surface tension on the position of a dividing surface, it was shown

that the conception of the surface of tension of Gibbs, and with this conception, the fundamental equations of thermodynamics of surface phenomena, can be applied to a monocrystal. The dependence of mean surface tension of a monocrystal on its size in connection with the conditions of flow of the process is discussed. Author

N65-16855 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF THE AgCl–NaCl–$PbCl_2$ SYSTEM. I: DIAGRAM OF FUSIBILITY AND COMPOSITIONS OF COEXISTING PHASES
A. A. Nazarov, M. M. Shul'ts, and A. V. Storonkin *In its* Herald of Leningrad Univ.: Phys. and Chem. Ser. 29 Sep. 1964 p 107–119 refs (See N65-16845 07-34)

The diagram of fusibility of the AgCl–NaCl–$PbCl_2$ system, and the compositions of coexisting phases were investigated at temperatures of 375° to 700° C. An immiscibility region in the system for solid solutions of NaCl–AgCl was found. The upper critical temperature of solutions appears to be between 410° and 450° C. Author

N65-16916# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics
[CRYSTALLIZATION, MELTING, AND SURFACE TENSION OF B_2O_3 AND FORMATION AND PROPERTIES OF AMORPHOUS ALLOYS] Progress Report, 1 Sep. 1963–1 Sep. 1964
David Turnbull 25 Sep. 1964 6 p refs
(Contract Nonr-1866(50))
(PR-1; AD-608761)

At one atmosphere pressure, pure boron oxide melts do not crystallize at appreciable rates even when seeded. Crystallization at pressures as low as 11.5 kilobars at 265° C, with no crystallization at temperatures up to 200° C at pressures under 40 kilobars, is reported. Surface tensions of boron oxide and silicon dioxide are small in relation to the corresponding cohesive energies, and surface tensions increase markedly with temperature. At lower temperature surface tension was determined by measuring creep rates of glass fibers. Preliminary investigation of the method gave a value of 80 ±8 ergs/cm^2 for the surface tension of selenium at 50° C. On the theory of glass structure, a novel method of packing uniform spheres is discussed. This is achieved by building out from a pentagonal dipyramid arrangement. The resulting structure has a density of 0.724 and a coordination number everywhere of 10. Vapor deposition of amorphous nickel–phosphorus alloys of the composition Ni_4P and an amorphous phase in the analogous cobalt–phosphorus system is also reported. E.E.B.

N65-16917# Illinois Univ., Urbana. Dept. of Physics
PHYSICS OF THE SOLID STATE Final Report
Robert J. Maurer Nov. 1964 9 p refs
(Contract Nonr-1834(19))
(AD-608672)

The work developed around two themes: (1) ionic mobility in the alkali halides, and (2) color centers in the alkali halides. The most significant results obtained on ionic mobility were the evidence for (1) a contribution of vacancy pairs to the self-diffusion coefficient of the chloride ion in sodium chloride, and (2) a high-temperature, high-frequency dielectric loss due to vacancy pairs in the alkali halides. Although detailed information was obtained on the interaction and relationships of H, V, F, and α color centers in the alkali halides, the most important contributions were: The evidence that (1) The H optical absorption band formed by X-rays at low temperatures is composed of overlapping bands due to H and V_K centers, and the determination of the position and shape of the band due to H centers. (2) Interstitial particles (H centers or interstitial halogen atoms) can be formed by low energy, ultraviolet photons in crystals containing the hydroxyl ion as an impurity. Author

N65-16930# Brown Univ., Providence, R. I. Div. of Engineering
THE EFFECT OF INCLUSION SHAPE ON THE ELASTIC MODULI OF A TWO-PHASE MATERIAL Technical Report No. 10
Tai Te Wu Oct. 1964 17 p refs
(Contract AT(30-1)-2394)
(NYO-2394-10)

A self-consistent model is used to calculate the elastic moduli of two-phase materials with the assumption that the inclusions are spheroidal. The limiting cases of needle- and disk-shaped inclusions are explicitly shown. It is found that the latter has the greater effect in changing the elastic moduli of the matrix. Author

N65-16944# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE Division 8 Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Alan L. Mc Whorter et al 18 Nov. 1964 17 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-560; AD-608569)

Research is reported in the fields of solid-state devices, lasers, materials, band structure and spectroscopy of solids, and magnetism and resonance. Laser action, in which coherent radiation at 5.2 microns emanates from the bulk of the semiconductor, was obtained from InSb diodes in which an electron-hole plasma was established. Laser action was obtained in GaAs at liquid helium temperature by generating electron-hole pairs with a beam of 50-keV electrons. Stimulated Raman emission at 90° to the ruby-laser beam in CS_2 was obtained, and the threshold was compared with that in nitrobenzene. An electric furnace was developed for heating samples to 2400° C in oxidizing atmospheres, as well as in neutral or reducing atmospheres. D.E.W.

N65-16971# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
FULLY SECOND-QUANTIZED HAMILTONIAN FOR INTERACTING ELECTRONS AND PHONONS
C. Alton Coulter (Alabama Univ.), D. W. Howgate, and R. A. Shatas 30 Nov. 1964 18 p refs
(RR-TR-64-18; AD-455955)

The multiparticle Schrödinger equation for an electron-ion system is used as the starting point for a derivation of the fully second-quantized Hamiltonian equation, which is expressed in terms of the correct creation and annihilation operators for both electron and phonon fields. The two most significant steps taken in this derivation are the transition from the Schrödinger equation to the corresponding second-quantized Hamiltonian, and the introduction of the true electron and phonon creation and annihilation operators which arise from the expansion of the electron and phonon field operators in appropriate sets of one-particle wave functions. It is then shown that the conventional phonon operators are equivalent to certain bilinear combinations of the true phonon creation and annihilation operators, at least in the subspace of states having only one "particle" present in each of the vibrational modes. The equality of the conventional and of the fully second-quantized Hamiltonians within this subspace of states follows immediately. Author

N65-16987*# Chicago Univ., Ill. Inst. for the Study of Metals
THE INFLUENCE OF IMPURITIES ON THE INTERACTIONS RESPONSIBLE FOR SUPERCONDUCTIVITY
Morrel H. Cohen [1963] 13 p refs
(Grant NsG-352)
(NASA-CR-55552) OTS: HC $1.00/MF $0.50

The nature of impurity resonances in electron energy bands is discussed for both simple- and transition-metal impurities in both simple- and transition-metal matrices. The effects of such resonances on the phonon-induced electron-electron interaction and on the dynamically screened Coulomb interaction are also discussed. It is concluded that transition-metal impurities in simple metals and vice versa will reduce the transition temperature if resonances occur, but that no corresponding effect occurs for transition-metal impurities in transition metals. Author

N65-16998# Harvard Univ., Cambridge, Mass. Cruft Lab.
MAGNETO-OPTICAL EFFECT IN FERROMAGNETIC METALS
B. R. Cooper, H. Ehrenreich, and L. Hodges 28 Sep. 1964 21 p refs *Its* Sci. Rept. No. 2 (Ser. 3)
(Contracts AF 19(628)-3874; ARPA SD-88)
(AFCRL-64-830; AD-608765)

The use of the Ferromagnetic Kerr Effect (FKE) is discussed in conjunction with band calculations for paramagnetic Ni and Fermi surface measurements, with a view toward developing a reasonable range of models for the band structure of ferromagnetic nickel near the Fermi energy. The use of the FKE is illustrated by determining two typical models in this range for the case of rigid splitting of the paramagnetic d-band structure near the Fermi energy. The extent to which these, as well as two earlier models give reasonable results for the FKE, other experimentally measured quantities, and the d-band splitting is discussed. Author

N65-17021# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics
THE THERMAL CONDUCTIVITY AND SEEBECK EFFECT OF IMPURE INDIUM ANTIMONIDE IN A MAGNETIC FIELD
Eldon F. Ault (M.S. Thesis) 1 Nov. 1964 56 p refs
(Contract Nonr-2964(01))
(TR-13; AD-608664)

The thermal conductivity and Seebeck coefficient of a single crystal of InSb, containing $3.3(10)^{18}$ tellurium atoms per cm^3 were studied. Measurements were made in the temperature range of 338° to 648° K, and at magnetic fields between 1000 and 8000 Gauss. The electrical conductivity had a value of $5.7(10)^3(Ohm\text{-}cm)^{-1}$ at 358° K. The thermal conductivity, determined by the series comparison method with Inconel 702 as standards, decreased from 0.14 W/cm-K° at 338° K to 0.091 W/cm-K° at 648° K. The Wiedemann–Franz ratio was used to determine the electronic component of the thermal conductivity from measured values of the electrical conductivity, and the difference was attributed to conduction by the lattice. The lattice thermal resistance was approximately twice that of pure InSb. The Seebeck coefficient varied from -15μ V/K° at 338° K to -109μ V/K° at 613° K, with the low-temperature values being less negative than theoretically predicted. A field of 8000 Gauss caused the thermal conductivity to decrease by 4.1% at 347° K to 7.7% at 578° K. The same magnetic field value caused the absolute value of the Seebeck coefficient to increase by 44% at 347° K to 2.9% at 578° K. Author

N65-17044# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
CRYSTAL-FIELD SPLITTING OF TRIVALENT THULIUM AND ERBIUM J-LEVELS IN YTTRIUM OXIDE, GENERAL RESEARCH
John B. Gruber (California Univ., Los Angeles), William F. Krupke, and J. M. Poindexter (California Inst. of Tech.) 18 Sep. 1964 66 p refs
(ATN-64(9216)-4)

The optical absorption and fluorescence spectra of trivalent thulium in single crystals of Y_2O_3, and the absorption spectrum of pure thulium oxide are investigated. All the SLJ-levels except the $^1S_0$ level expected for the 4f electronic configuration are identified. The three Slater integrals and spin-orbit parameter giving the best overall agreement between observed spectrum and the predicted free-ion spectrum are $F_2 = 446.695\ cm^{-1}$, $F_4 = 70.491\ cm^{-1}$, $F_6 = 7.534\ cm^{-1}$, and $\zeta = -2617.015\ cm^{-1}$. A set of free-ion wave functions, computed from these parameters, is used to compute operator equivalent factors for Tm^{3+} in Y_2O_3. A detailed crystalline-field perturbation calculation is carried out for trivalent thulium and erbium ions in the C_2 sites of the Y_2O_3 lattice. The average deviations between the predicted crystalline Stark components and the observed levels for 70 levels in the Tm^{3+} spectrum and 70 levels in the Er^{3+} spectrum are 11.1 cm^{-1} and 10 cm^{-1}, respectively. The use of single crystals of Tm^{3+} in Y_2O_3 as a laser material is discussed in detail in the appendix. Author

N65-17050# New Mexico Univ., Albuquerque.
AN EXPERIMENTAL DETERMINATION OF ULTRASONIC WAVE VELOCITIES IN PLASTICS AS FUNCTIONS OF TEMPERATURE
Ned D. Arnold (M.S. Thesis) 1964 53 p refs Supported by AF
(AD-608347)

An apparatus was set up to measure longitudinal ultrasonic wave velocities. The method used to determine velocity is based on measuring the times required for ultrasonic pulses to travel through samples of different lengths. The method is capable of measuring velocities through samples a few millimeters thick, with an error of no more than 4%. The velocities of longitudinal waves through several plastics were determined at temperatures between room temperature and 100° C. Velocity–temperature curves are given for five common plastics. D.E.W.

N65-17076# Pennsylvania State Univ., University Park. Materials Research Lab.
RESEARCH ON ELECTRON-PHOTON INTERACTION PHENOMENA Interim Technical Report, 3 Sep.–2 Dec. 1964
H. K. Henisch 15 Dec. 1964 21 p refs
(Contract DA-44-009-AMC-581(T))
(ITR-2; AD-456004)

In the study of the theory of photoeffects at metal–semiconductor contacts, effort is concentrated on the development of a model that would permit calculation of floating potentials at these contacts and, more generally, the calculation of voltage–current characteristics of contacts under illumination. The method and the construction of equipment for measuring carrier lifetime in n-p-n heterojunction devices is described. The choice of growth method and transport materials, and the assembly of equipment is discussed for the preparation of Ge-GaAs heterojunctions. Progress is also reported in the

study of photocapacitive effects, in the preparation of transparent conducting electrodes on glass and quartz, and in the selection of dispersion medium. D.S.G.

N65-17080# Army Electronics Labs., Fort Monmouth, N.J. Electronic Components Dept.
OPTIMIZING FAST SOLID-STATE PHOTOCONDUCTIVE CELLS FOR PCM APPLICATIONS
Herbert L. Mette Sep. 1964 14 p refs
(ECOM-2497; AD-610011)

This report discusses the characteristics of photoconductive devices in general terms relative to their basic semiconductor parameters, particularly for the detection of very short light signals. Included are two cases to be distinguished, i.e., where the pulse length is longer or where it is shorter than the carrier lifetime. In the first case, the risetime, decaytime, and maximum signal sensitivity are almost completely determined by the lifetime alone, while in the second case the risetime and signal sensitivity are independent of the lifetime and only dependent on the length and integral over the intensity of the light pulse. Methods for optimizing cell parameters for both modes of operation are examined, and the use of photoconductive cells for the detection of pulse-code modulated signals is discussed. Author

N65-17086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ULTRASONIC VIBRATIONS ON THE CRYSTALLIZATION AND PROPERTIES OF ALLOYS
V. S. Smirnov, A. F. Chudnovskiy et al 2 Dec. 1964 12 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Leningrad), No. 222, 1963 p 8–14
(FTD-TT-64-368/1+2; AD-609916)

Use of ultrasonic vibrations in the production of alloys with fine crystalline structure and more uniform physical properties is reported. Improvement in microhardness without change in electrical properties was observed. It was concluded that ultrasonic crystallization of thermoelectric alloys, as a new method for obtaining thermoelements, merits further development. E.E.B.

N65-17091# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.
ELECTRO-OPTICAL MATRIX DISPLAY Interim Development Report, 1 May–31 Jul. 1964
Robert J. Spain et al Sep. 1964 17 p
(Contract NObsr-91199)
(IDR-480-Q1; AD-608563)

The initial phase of the program directed toward the fabrication of a workable electro-optical display using the magnetic properties of RIS 1 thin films in conjunction with the Bitter powder pattern technique is described, and the results of material investigations along these lines are presented. The dependence of many of the properties of the magnetic film elements upon the conditions of preparation are detailed. The problems involved in the preparation of improved Bitter colloids were investigated. Author

N65-17097# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
POLARIZATION EFFECTS ON MAGNETIC RESONANCES IN FERROELECTRIC POTASSIUM TANTALATE
Stuart H. Wemple (Ph.D. Thesis) 31 Dec. 1964 87 p refs
(TR-425; AD-609911)

Electric field effects on electron paramagnetic resonances (EPR) associated with Fe^{3+} impurity ions in the perovskite ferroelectric $KTaO_3$ are presented and discussed. A large effect ($D = 30 \times 10^{-4}\ cm^{-1}$ for $E = 14$ kv/cm) was predicted and observed at 4.2° K. Because the extrapolated Curie temperature of $KTaO_3$ is close by (~0° K), large lattice polarizations and electrostrictive strains are induced by an externally applied electric field. This gives rise to a shift of the paramagnetic energy levels that is quadratic in the applied field. The effect is several orders of magnitude larger in $KTaO_3$ than has been reported for other centrosymmetric lattices. The EPR angular dependence data for the Fe^{3+} ion in a cubic environment are interpreted in terms of appropriate spin Hamiltonian parameters. Optical absorption spectra associated with Fe, Mn, and Co impurities are also reported. A method for growing fairly large (~1 cm^3) and good quality single crystals of $KTaO_3$ is described. Author

N65-17099*# Little (Arthur D.), Inc., Cambridge, Mass.
INVESTIGATION OF THE SUPERCONDUCTING PROPERTIES OF TRANSITION METAL ALLOY SYSTEMS Final Report
Aug. 1964 20 p refs
(Contract NASw-733)
(NASA-CR-60717; C-65643) OTS: HC $1.00/MF $0.50

The critical current characteristics of niobium–zirconium superconducting alloys were investigated. This study was concerned with the effect of the ω-transformation on superconductivity. The transformation was studied in detail, and the purpose was to apply this knowledge to the changes in superconducting properties as the transformation occurs. Author

N65-17113# Lowell Technological Inst. Research Foundation, Mass.
EFFECTS OF EXTERNAL FORCES ON VIBRATING CRYSTAL PLATES Fifth Quarterly Report, 1 May–31 Jul. 1964
Charles R. Mingins, Robert W. Perry, and Luther C. Barcus [1964] 48 p refs
(Contract DA-36-039-AMC-02239(E))
(Rept.-13; AD-452312)

Research was continued in the reaction of vibrating quartz piezoids to the setting up of steady stresses, whether tensile or flexural. The curves of frequency deviation as a function of azimuthal angle for cantilever flexure were found to have the same general form in rectangular as in circular plates. In the curves for tensile stress, differences in the degree of asymmetry were found for different plate resonance frequencies. Studies are reported of the variations caused by different widths and positions of clamps, and the relation of these variations to the form of the force field is considered. Valuable conclusions are drawn from the collateral use of cemented tensile mountings. The high degree of constancy of the stress coefficient of frequency presents a tool of great utility in examining the interactions between the form of the force field and the distribution pattern of vibrational amplitude. Author

N65-17140# HP Associates, Palo Alto, Calif.
INVESTIGATION OF HOT ELECTRON EMITTER Scientific Report No. 9, Jul. 1–Oct. 31, 1964
Richard W. Soshea 15 Nov. 1964 21 p ref
(Contract AF 19(628)-1637)
(AFCRL-64-953; AD-610195)

The attenuation length of hot electrons in platinum has been studied by the photoelectric method using Pt-Si

Schottky barriers. The hot electron attenuation length in these films is equal to or less than 120Å. The resistivity of Pt films is in the range of 20 to 30 microhm-cm, indicating that the films may contain a sufficient density of structural defects to influence the hot electron attenuation length. Rhodium–silicon Schottky barriers have been made which exhibit a barrier height of 0.78 volts. The barriers show no degradation during vacuum heating at temperatures as high as 600° C. Author

N65-17176# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF SMALL ADDITIONS OF OXIDES OF YTTRIUM, LANTHANUM, AND CERIUM ON CERTAIN MAGNETIC CHARACTERISTICS OF MAGNESIUM–MANGANESE FERRITES AND THE X-RAY SPECTRA OF TRANSITIONAL METALS IN THEM

E. Ye. Vaynshteyn, A. I. Gunchenko et al 18 Dec. 1964 12 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 6, 1962 p 72–80 refs
(FTD-TT-64-450/1+2; AD-610349)

The effect of admixtures of lanthanum, cerium, and yttrium oxides on the magnetic characteristics of manganese and magnesium–manganese ferrites differs for various rare-earth elements, and depends on their content in the ferrite. The fine structure of the X-ray absorption spectra of iron, and manganese, in ferrites with various quantities of rare-earth elements, was investigated. Based on an analysis of the experimental data, inferences were drawn as to the possible mechanism of the effect of admixtures on the energetic state of the atoms in the basic ferrite components. Author

N65-17177# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROPERTIES OF FILM PICKUPS OF HALL EMF AND THEIR APPLICATION TO MEASURING MAGNETIC FLUXES

O. D. Yelpat'yevskaya 17 Dec. 1964 8 p Transl. into ENGLISH from Elektroprivod i Avtomatiz. Prom. Ustanovok G.E.I. (Moscow), 1960 p 467–469
(FTD-TT-64-452/1+2; AD-610274)

The properties of thin layer semiconductor materials differ significantly from those of solid specimens. This is particularly true of electron mobility and the Hall effect. The production of thin layers of HgSe and HgTe for semiconductor application is reported. Advantages of the thin layer materials and applications in technology are discussed. E.E.B.

N65-17196# Sandia Corp., Albuquerque, N. Mex.

NEUTRON BOMBARDMENT REDUCTION OF TRANSISTOR CURRENT GAIN

C. A. Goben Dec. 1964 98 p refs Sponsored by AEC
(SC-R-64-1373) OTS: $3.00

Emitter efficiency in neutron bombarded transistor measurements reveals the following: (1) The base recombination term is not solely responsible for all the neutron-induced degradation of transistor gain. (2) The emitter efficiency is a very sharply decreasing function of integrated neutron flux, and is responsible for a large fraction of the neutron degradation of transistor current gain. (3) The base region parameter changes are similar to changes observed in bulk material. (4) The neutron-induced component of current arises from the same type of recombination centers as the surface-perimeter current. (5) The neutron-induced recombination centers anneal at different rates in the bulk and space charge regions. E.E.B.

N65-17267*# National Aeronautics and Space Administration, Washington, D. C.

ON THE EFFECT OF ANNEALING IN A MAGNETIC FIELD ON THE MAGNETIC AND CRYSTAL STRUCTURE OF SILICON IRON [O VLIYANII OTZHIGA V MAGNITNOM POLE NA MAGNITNUYU I KRISTALLICHESKUYU STRUKTURU KREMNISTOGO ZHELEZA]

R. A. Adamesku, V. M. Kalinin, and I. P. Kudryavtsev Mar. 1965 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 5, 1964 p 69–74
(NASA-TT-F-9267) OTS: HC $1.00/MF $0.50

The torque anisotropy in a strong magnetic field was measured in industrial specimens of cold-rolled transformer steel, under three conditions: (1) immediately after standard factory annealing; (2) after additional annealing without an external magnetic field but with slow cooling; and (3) after magnetic annealing. The presence of magnetic texture was established by means of the longitudinal and transverse magnetorestriction curves. The amplitude A_2 of the torque curve is determined both by the inherent crystalline and induced magnetic anisotropy, while A_4 is governed solely by the crystalline anisotropy. It is shown that magnetic annealing gives rise not only to orientation of the magnetic domains, but to modification of the crystal structure of the material as well. Hypotheses are advanced concerning the mechanism of these modifications. The numerical value of the induced magnetic anisotropy constant is determined. Author

N65-17345# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF SUPERCONDUCTING ALLOYS IN THE SYSTEM Nb-Zr

Z. A. Guts, N. M. Reynov, N. I. Krivko, T. A. Sidorova, and A. A. Fogel 2 Jan. 1964 8 p refs Transl. into ENGLISH from Fiz. Tverd. Tela (Leningrad), v. 5 no. 1, 1963 p 361–362
(FTD-MT-63-150; AD-605895)

Superconductivity of niobium–zirconium was investigated at 4.2° K in an electromagnetic field of about 30 000 oersteds. Also investigated was the effect of heat treatment on superconductivity. Preliminary refining of the niobium, preparation of the alloy in vacuum of 10^{-5} mm Hg, and effects on the properties of the alloy are discussed. It was observed that the preliminary refining of the Nb had a marked effect on the hardness of the alloy, and that heat treatment broadened the area of superconductivity of the Nb-Zr alloy. E.E.B.

N65-17391# Brandeis Univ., Waltham, Mass. Dept. of Physics

ON POLARIZED POSITRON ANNIHILATION IN FERROMAGNETS

Stephan Berko and Joel Zuckerman [1964] 10 p refs Sponsored by NSF and the Army
(AROD-3389-3; AD-455917)

Positrons from a Na^{22} source were collimated and allowed to strike 3/8-inch-diameter iron and nickel samples. The magnetic field was set parallel (↑) and antiparallel (↓) to the incident positron momentum. The resulting photons from the positron–electron singlet annihilation were counted. At each counting angle two rates N (↑) and N (↓) were obtained with an automatic cycling through the predetermined angular range. A small polarization effect at quite large angles, reversal in sign, and an indication of peaking in the Fermi radius region were observed. It was concluded that the interpretation of polarization experiments somewhat

model dependent; reversal in sign of the polarization, in itself, does not constitute a direct proof of the conduction band polarization; and antiparallel conduction band polarization was indicated. E.E.B.

N65-17417# Texas A&M Univ., College Station.
THERMOLUMINESCENCE BIBLIOGRAPHY
Ernest E. Angino, N. Grogler (Bern Univ.), and Richard Mc Call (Controls for Radiation, Inc.) Feb. 1965 101 p refs
(TID-3911;, Rev. 2) OTS: $4.00

N65-17419# Los Alamos Scientific Lab., N. Mex.
METHOD FOR HIGHLY ACCURATE NUMERICAL SPATIAL INTEGRATION: APPLICATION TO LATTICE DYNAMICS OF CUBIC TYPE CRYSTALS
W. C. Overton, Jr. and A. F. Schuch 18 Jan. 1965 51 p refs
(Contract W-7405-ENG-36)
(LA-3162) OTS: $3.00

The vector-interpolation method for machine computation of the frequency distribution $G(\nu)$ of lattice vibrations is greatly improved and extended. A procedure is developed which permits the design of an exactly uniform N-vector distribution (for any N) inside one of the typical 1/48 symmetry-irreducible trihedral solid angles which characterize highest cubic symmetry. An analysis is made of the errors committed in calculating $G(\nu)$ by the vector-interpolation method. The effect on the error of anisotropy of the constant-frequency surfaces inside the Brillouin zone is found. A sample calculation is made for a face-centered cubic lattice model for the highly anisotropic frequency surface of an important Van Hove critical point frequency. Author

N65-17423# Massachusetts Inst. of Tech., Cambridge.
ELECTRONIC BAND STRUCTURE OF TiC, TiN, AND TiO
V. Ern and A. C. Switendick Oct. 1964 28 p
(Contracts Nonr-1841(10); AF 33(616)-8353; Grant NSF-GP-3241)
(TR-192; AD-608826)

The band structure of metallic face-centered cubic TiC, TiN, and TiO has been obtained by the augmented plane wave (APW) method at the equivalent of 256 points in the Brillouin zone, and for an energy range appropriate to cover the nonmetal 2s and 2p and the titanium 3d and 4s states. A density of states, the Fermi energy, and contours of constant energy were obtained for the three compounds. A charge distribution in the APW scheme was derived from the equivalent of 32 points in the zone, and the admixture of the bands was analyzed. The results are consistent with the available experimental data. Author

N65-17477# Compagnie Generale de Telegraphie sans Fil, Puteaux (France).
RESEARCH ON FERRITES INTENDED TO THE ELECTRIC SCANNING OF HERZIAN BEAMS Final Report, 6 Aug. 1963–6 Aug. 1964
A. Vassiliev 22 Sep. 1964 63 p refs
(Contract DA-91-591-EUC-3085)
(AD-455417)

Lithium ferrites and substituted lithium ferrites were studied in order to realize substances with rectangular hysteresis loops having low coercitive fields and low dielectric losses, in view of phase shifting applications for herzian beam scanning. The following compounds were realized for the best available raw material and to determine the optimum presintering and sintering temperatures:

$$Li_2O\,5(1-X)[(1-y)Fe_2O_3\,y\,Al_2O_3]2zMnO_2.$$

The values of x, y, and z and the raw materials are presented in a table. Presintering was performed at 600° to 900° C, and the sintering at 1110°, 1125°, 1150°, 1175°, 1200°, and 1225° C. The obtained results are presented in tables. G.G.

N65-17496# Frankford Arsenal, Philadelphia, Pa.
BIREFRINGENT EFFECTS IN IRRADIATED ALKALI HALIDES
Edwin R. Levin, Michael A. Shields, Elmer L. Offenbacher, and David B. Rosenblatt Oct. 1964 28 p refs
(R-1737; AD-452146)

Crystals of various alkali halides were irradiated with alpha particles from a variety of sources, principally uranyl nitrate, uranium, and polonium. The studies were primarily concerned with effects produced by integrated fluxes of about 10^8 alphas/cm^2, significantly lower than is usual in such work. Although considerable difficulty was encountered in delineating the conditions under which irradiation effects appear, many birefringent effects were observed. These appear to be surface crystallite formations of alkali nitrates. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-16573# Southwest Research Inst., San Antonio, Tex.
EFFECT OF ADDITIVES ON THE STORAGE STABILITY OF HIGH-TEMPERATURE FUELS Final Technical Report, 15 Jun. 1963–14 Nov. 1964
Robert K. Johnston and E. L. Anderson Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 143 p refs
(Contract AF 33(657)-11246)
(RS-433; AFAPL-TR-64-142; AD-454998)

A study was made of the use of additives to prevent or retard the deterioration of JP-6 fuel thermal stability during storage. Fuel-additive blends were stored at 130° F in sealed 15-gallon steel drums for periods up to 16 weeks. Thermal stability was measured by means of a modified fuel coker developed during this program, using helium pressurization instead of a fuel pump. The standard ASTM-CRC fuel coker and the Eppi-CRC modified fuel coker were found to be unsuitable for this purpose, due to contamination of the test sections with pump wear debris. A total of 52 additives were submitted for evaluation, from which 19 were selected by screeening tests for inclusion in the hot-room storage program. Three JP-6 fuels were used as the base stocks for additive evaluation. Under storage conditions giving a 100° F decrease in base fuel thermal stability, four additives or combinations of additives were found to be effective in maintaining thermal stability. These results indicate that the use of additives is a feasible approach to solving current problems in this area. Author

N65-16644# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Stuttgart (West Germany). Institut für Raketentreibstoffe
RESEARCH ON THE DINITROGENTETROXYDE AND TETRANITROMETHANE SYSTEM [UNTERSUCHUNGEN AM SYSTEM DISTICKSTOFFTETROXYD-TETRANITROMETHAN]
F. Bachmaier Oct. 1964 29 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-29; DVL-371) Available from ZLDI, Munich: DM 8.60

The most important rocket data on mixtures of nitrogen tetraoxide and tetranitromethane were determined. Vapor pressures, densities, viscosities, and freezing points were determined as a function of mixture composition. Ignition characteristics of these mixtures were compared with a fuel composed of hydrazine and unsymmetrical di-methyl hydrazine. Regarding vapor pressure, density, and viscosity no significant results were obtained. The thermal analysis of the freezing point with a ratio of 65 wt % tetranitromethane to 35 wt % nitrogen tetraoxide results in an eutectic about −29° C. Within the range of 0 to 90 wt % of tetranitromethane the ignition characteristics are not influenced. Author

N65-16818# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
HAZARDS DUE TO HYDROGEN ABOARD A SPACE VEHICLE Annotated Bibliography
Gus J. Caras, comp. Sep. 1964 24 p
(RSIC-291; AD-454478)

The bibliography consists of 23 annotated references on the subject of hazards to space vehicles as a result of hydrogen leaks. The references treat such topics as hydrogen-leak detection, and suppression of fires and explosions. Because the subject of hydrogen safety is rather broad, an attempt was made to include only those references which were related in some way to safety of space cabins or similar compartments. Author

N65-17137# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab.
STABILITY OF HIGH-TEMPERATURE, HYDROCARBON JET FUELS DURING STORAGE Technical Documentary Report, May 1962–Jan. 1964
Herbert R. Lander, Jr. Nov. 1964 86 p refs
(APL-TDR-64-107; AD-610591)

The Air Force has encountered problems of storing fuel for high-speed, air-breathing aircraft. The thermal stability of high-temperature, hydrocarbon jet fuels is affected by periods of storage. During storage, jet fuels must retain their physical and chemical characteristics. Eighteen JP-6 fuels and nine thermally stable fuels were stored for various periods of time; data are presented on the results. After only 30 weeks of ambient storage, eight JP-6 fuels failed to pass the minimum specification requirements for thermal stability. All of the fuels monitored passed the thermal stability requirement when procured by the Air Force. The critical period in the life of high-temperature fuels regarding thermal stability occurs in the early storage period. Handling, transfer, and fuel deterioration are cited as possible influences on this early storage degradation. Author

N65-17256*# Harris Research Labs., Inc., Washington, D. C.
STUDIES OF INTERFACIAL SURFACE ENERGIES Summary Report
George A. Lyerly and Henry Peper 31 Dec. 1964 30 p refs
(Contract NAS3-5744)
(NASA-CR-54175) OTS: HC $2.00/MF $0.50

The contact angles of liquid propellants on prepared surfaces of tank materials were experimentally determined. The surface tensions and densities of the liquid propellants were determined to complement the contact angle measurements. Initial low contact angles in the range of 2° to 0° accompanied by spontaneous spreading were observed for drops of each liquid on each solid substrate. Aging experiments showed that most of the liquid–solid systems observed remained wet. The exceptions were the liquid–solid pairs of conductivity water on polished aluminum and stainless steel surfaces and of 90% hydrogen peroxide on polished aluminum surfaces. The Marangoni or "wineglass" effect was observed to occur in the spreading of uns-dimethylhydrazine (UDMH), Arizine-50, and dinitrogen tetroxide on each solid surface. This effect was observed also for 90% hydrogen peroxide on satinized stainless steel. Over the time period that the Marangoni effect was observed, the liquids wet the solid surfaces with a true zero contact angle. Author

N65-17394# Melpar, Inc., Falls Church, Va.
MECHANISM OF MICROBIOLOGICAL CONTAMINATION OF JET FUEL AND DEVELOPMENT OF TECHNIQUES FOR DETECTION OF MICROBIOLOGICAL CONTAMINATION. PART I: RELATIONSHIPS BETWEEN ALUMINUM CORROSION, SLUDGE FORMATION, AND MICROBIAL METABOLISM First Interim Summary Report, 1 Mar. 1963–1 Jan. 1964
Jan. 1964 135 p refs
(Contract AF 33(657)-9186)
(APL-TDR-64-70, Pt. 1; AD-607062)

Progress was reported in the following areas: (1) Two assays using tetrazolium reduction were developed for the detection of small numbers of fuel microorganisms. (2) Growth of microorganisms in fuel-water media causes chemical changes in environment which result in a changing microbial flora. During growth in a closed system the pH and oxygen level decrease but the E_h and CO_2 levels increase. (3) The conditions for demonstrating microbial corrosion were further defined. The corrosion studies carried out were of value in showing the multiplicity of factors entering into the corrosion process. (4) Research on the nutrition of fuel-oxidizing *Pseudomonas* resulted in the formulation of a fuel-water medium capable of yielding 100 times the growth observed on any medium described in the literature. (5) Differences have been observed in survival of normal nonfuel-utilizing organisms and fuel-utilizing organisms when exposed to fuel. Fuel is not toxic to normal cultures in the presence of rich media. In fuel-water media, however, only fuel organisms survive. Author

N65-17415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICAL COMPOSITION OF MICROIMPURITIES IN JET FUELS FROM SULFUROUS PETROLEUM
V. N. Zrelov, N. I. Marinchenko et al 19 Nov. 1964 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 11, 1963, p 57–61
(FTD-TT-64-392/1; AD-608734)

The microimpurities of the jet fuels from sulfurous petroleums consist of ash elements, tars, and "structural" water. In the process of transportation, settling, and filtration of the fuels there occurs a separation of the microimpurities in accordance with their chemical composition; those saturated with ash elements settle and are filtered out in the mesh filters of the airplanes, and those saturated with tar products and water basically remain in the fuel in the suspended state. Up to 20% or 30% of oxidized compounds containing sulfur go into the composition of the tarry part of the microimpurities. In the

process of the filtration of fuels, the quantity of compounds containing sulfur is decreased. The sulfur compounds are retained in the storage fabric filters and the airplane paper filters, for which reason the latter quickly become clogged. The principal amount of microimpurities containing sulfur is held back by the fabric filters of the first step in filtration at the fuel storage places. Author

N65-17476# Rocketdyne, Canoga Park, Calif.
STUDY OF AN ENDOTHERMIC FUEL FOR THE ATLAS ROCKET MOTOR Second Quarterly Progress Report for Period Ending 30 Nov. 1964
W. S. Hines and J. D. Seader 17 Dec. 1964 24 p refs
(Contract AF 04(611)-9721)
(RM-1105/362; AD-454771)

A series of forced convection tests were conducted with tetraisobutylene (TIB) in electrically heated tubes at pressures from 550 to 890 psia, liquid velocities from 47 to 267 ft/sec, liquid bulk temperatures from 90° to 290° F, and heat fluxes up to 4.85 Btu/in.^{2}-sec. The data agreed with the correlation $Nu = 0.005\ Re^{0.95}\ Pr^{0.4}$, indicating that the analytical predictions about TIB cooling capabilities were correct. Chromatographic analyses of on-line TIB samples from the experimental apparatus indicated no decomposition of fuel was occurring under the test conditions; however, substantial coke deposition was encountered at inner tube wall temperatures above 400° F. The flow system was modified to permit convection experiments at fluid temperatures over 350° F, and preparations were made to perform a series of burnout tests with TIB. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-16472# Astrosystems International, Inc., Fairfield, N. J.
INVESTIGATION OF SPACECRAFT ROCKET INSTALLATION AREAS. VOLUME I: SURVEY AND STUDIES Final Report, 1 May 1963–31 Jul. 1964
Stanley Lehrer Edwards AFB, Calif., AF Rocket Propulsion Lab., Nov. 1964 99 p refs
(Contract AF 04(611)-9084)
(TR-63038F, Vol. I; AFRPL-TR-64-141, Vol. I; AD-451275)

The main objective of this program is to establish design criteria for space vehicle propulsion system installation. This volume covers an industry survey, inspace propellant leak hazards studies, and inspace maintenance studies. The results of the survey conducted under this program demonstrated that a need exists for expanded and organized attention to the critical area of engine-vehicle functional interface in spacecraft operations. In the propellant leak hazards area, a set of safety design criteria based on study and literature review was established. A number of areas requiring experimental investigation were uncovered and an outline of testing presented. In the inspace maintenance study, a number of propulsion system design criteria were evolved to simplify inspace maintenance of propulsion systems. Author

N65-16571# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR PROGRAM Technical Note, 1 Oct.–31 Dec. 1964
30 Jan. 1965 127 p
(Contract AF 04(695)-350)
(AFRPL-TDR-65-24; AD-456562)

In demonstration tests, the first Mod 260 ignition motor and retention-and-release system performed as designed. The ignition motor was contained in flight and impacted in the desired area. Based on the results of the first functional test, the retention-and-release system will present no hazards to the 260-SL motor tests. Visual and radiographic examinations of vertical batch mixed ANB-3105 propellant have shown that a low void content can be obtained when degassed Paracril RF-2 is used. The constant strain properties of the samples were satisfactory. Assembly welding of the chamber for motor 260-SL-1 and of the nozzle shell were completed. Longitudinal welding of the aft head and the five cylindrical sections of the 260-SL-2 motor chamber, and of the nozzle-shell cone segment, was also completed. Three design changes were made to the 260-SL-motor nozzle as a result of posttest evaluation of the 120-SS-1 motor firing. Author

N65-16589*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF A CONSTANT-VELOCITY TRAVELING MAGNETIC WAVE PLASMA ENGINE
Robert E. Jones and Raymond W. Palmer Washington, NASA, Feb. 1965 26 p refs Abbreviated version presented at the 5th Symp. on the Eng. Aspects of Magnetohydrodyn., MIT, 1–2 Apr. 1964
(NASA-TN-D-2676) OTS: HC $1.00/MF $0.50

The traveling magnetic-wave plasma engine has been redesigned to reduce the high heat loss to the tube walls downstream of the last magnetic-field coil. The present configuration uses a 3-in.-diameter pyrex tube flared out to a 6-in. diameter immediately downstream of the last magnetic-field coil, and was studied to determine the effects of flared-tube geometry, molecular weight of the propellant, engine length, and use of a ferrite core on the engine performance. Argon and xenon gases were used as propellants, and two engine lengths were tested. One engine was nominally 1 magnetic wavelength long (4 coils) and the other nominally 2 1/2 magnetic wavelengths long (10 coils). The magnetic wave speed for both lengths corresponds to a specific impulse of 4750 sec. The maximum kinetic efficiency of the 4-coil engine was 10% at a specific impulse of 3200 sec using argon gas and 22.5% at 4200 sec using xenon gas as the propellant. Increasing the engine length had a negligible effect on the performance with argon gas; but resulted in lowered performance with xenon gas. The efficiency of the 4-coil engine with the ferrite core installed was significantly lower than that obtained when no core was used. Author

N65-16672# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center
DISCUSSION OF THE RL10 ENGINE APPLIED TO APOLLO PROPULSION
12 Mar. 1964 77 p
(PWA-FR-918)

The RL10 engine, originally developed for the Centaur and Saturn S-IV programs, can be readily adapted to meet the Apollo propulsion system requirements because it was designed for multiple start operation in a deep space environment. The 15000-lb-thrust RL10A-3 engines, which use liquid hydrogen and liquid oxygen as propellants, deliver an

average specific impulse of 434 sec at 200 000-ft-altitude conditions at a nominal mixture ratio of 5.0 to 1. Precise increments of total impulse are possible because the RL10 can be stopped at any time during operation. Cutoff is sharp and predictable. The RL10A-3-A incorporates some additional crew safety measures not required for unmanned application. The RL10A-3-2A provides the capability of operating in a pressurized mode at very low thrust levels to settle propellants and to throttle up to 10% of rated thrust. The applicability of the RL10 to Apollo propulsion requirements is summarized in respect to durability, combustion stability, contamination susceptibility, high vacuum operation, susceptibility to micrometeoroid damage, multiple start capability, propellant system conditioning, mixture ratio, qualification tests, throttling, hypergolic ignition, low idle, and dual ignition. R.L.K.

N65-16790# Pyrogenics, Inc., Woodside, N. Y.
DEVELOPMENT AND DEMONSTRATION OF NOZZLES USING BULK PYROLYTIC GRAPHITE Interim Progress Report, Jul. 1–Sep. 30, 1964
30 Sep. 1964 17 p
(Contract AF 04(611)-9903)
(IPR-1; AD-608534)

This is a summary of the development of nozzles using bulk pyrolytic graphite. The first 1.120-inch nozzle was designed, and the first unit utilizes a plane oriented insulating pyroid insert. Preliminary heat transfer, temperature profile, stress and erosion calculations were performed for the initial design, and these calculations will be used in conjunction with test firing results to design the larger 2.3-inch demonstration nozzles. Design of the second development nozzle was initiated, and this unit utilizes partial edge oriented approach to compare performance with the plain oriented unit. Author

N65-16911# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Research Div.
DESIGN OF A MODULAR SOURCE CONTACT ION ENGINE Final Report, 15 Mar. 1963–30 Jun. 1964
S. G. Forbes, J. C. Beynon, and M. E. Kirkpatrick Nov. 1964 110 p refs
(Contract AF 33(657)-10788)
(STL-8417-6018-RU-000; AFAPL-TR-64-126; AD-608619)

The design, fabrication, and test of a two module engine, capable of 20 mlb of thrust with a grid replacement mechanism, are discussed. Also included are analyses which calculate the grid erosion rate due to charge exchange ionization, and rocket efficiency penalties associated with high engine weight and off-optimum I_s design. With the emitter available, representative operational characteristics were these: at 4600 sec I_s, 62% electrical efficiency and 163 kW/lb; at 6950 sec I_s, 80% electrical efficiency and 190 kW/lb. Propellant utilization was 0.94 or greater. The grid replacement weight is equivalent to a propellant utilization of not less than 90%. Engine weight is 1 Kg/ampere of ion beam. Emitter material currently developed should permit operation with this same engine design at 80% electrical efficiency at 5000 sec. The feasibility of replacing the accelerating grid structure in a high perveance contact ion thrustor has also been demonstrated. Author

N65-16963# Thiokol Chemical Corp., Huntsville, Ala. Engineering Research Dept.
EVALUATION OF THE LYON, INC. FORTY INCH DIAMETER ROCKET MOTOR CASE FABRICATED BY THE HOT CUP–COLD DRAW PROCESS Phase Report
David L. Daigle 29 Jan. 1965 156 p
(Contract DA-01-021-ORD-11919)
(Rept.-305-65; AD-455918)

The case was made from D6AC steel by a hot cup–cold draw process and conformed generally to the Pershing second-stage motor-case configuration. After dimensional and radiographic inspections, the case was subjected to a hydrostatic proof pressurization test, a hydrodynamic pressurization test, and a hydrostatic burst pressurization test, all conducted at −65° F. The case performance under the low temperature pressurization tests was entirely satisfactory. The case failed in a ductile manner at a biaxial strength level of 274 000 psi. The performance of the Lyon case was compared to the performance of two other Pershing second-stage motor cases manufactured with D6AC steel. Based on the comparison, it appears that the performance of the Lyon case under pressurization differs little from the performance of the second-stage Pershing cases presently being manufactured. Author

N65-17218# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 8
15 Feb. 1965 18 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-8)

High temperature split disk turbine rotor design is reported. The design has retained the desirable feature of interchangeability of rotor blades but does have the attendant disadvantages of high weight, close tolerance requirements, and relatively complex cooling air passages. Also, fabrification of the cascade stator blades has progressed with the complete machining of the spars for the first lot. A photograph of the assembled cascade rig is included. E.E.B.

N65-17251# Bell Aerosystems Co., Buffalo, N. Y.
REACTION CONTROL ENGINES AND POSITIVE EXPULSION TANKAGE FOR SPACE VEHICLES
Jan. 1964 125 p
(Rept.-8500-945006)

Described in detail are radiation-cooled, and ablative bipropellant thrust chambers. Peroxide thrust chambers for reaction control in the Centaur, Mercury, and X-20 programs are summarized, including structural requirements, pulse performance photographs, and layouts. Positive expulsion tankage developments, including the use of double-convoluted metal bladders, are reviewed. R.L.K.

N65-17464*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF TURBOPUMP FEED SYSTEMS FOR HYDROGEN–NUCLEAR ROCKETS
Warren J. Whitney Washington, NASA, Mar. 1965 19 p refs
(NASA-TN-D-2712) OTS: HC $1.00/MF $0.50

The feasibility of low temperature topping turbine systems, bleed rates for bleed turbine systems, and the possible advantage of a combination bleed and topping system were investigated. The range of chamber pressure investigated was from 300 to 1000 psia, and the range of system loss assumed was from 350 to 750 psi. Conservative estimates of the pump and turbine component efficiencies were used, and conservative mechanical design limitations were observed. The results are commensurate with current mechanical design technology and component performance expectations. The results of the topping turbine driven feed systems showed that for turbine inlet temperatures of 1200° R or above the topping turbine pressure

ratio would be small and would not represent a major consideration affecting the system feasibility. The feasibility of topping systems was shown to be critically dependent on turbine inlet temperature in the range 300° to 500° R. The decrease in bleed rate is the reflection of improved turbine performance of the two-shaft bleed system, which effects a six-stage turbine within the mechanical limitation of three stages per unit. A combined bleed and topping system was examined for system conditions of 800-psia chamber pressure and 450-psi system loss. The combination bleed and topping system offers an advantage in bleed rate over a pure bleed system for assumed engine conditions for which a pure topping system would not function. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-16400 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RECORDING THE EFFECTS OF THE HIGH-ALTITUDE THERMONUCLEAR EXPLOSION OF 9 JULY 1962 WITH THE "KOSMOS-5" SATELLITE

Yu. I. Gal'perin and A. D. Bolyunova *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 173–190 refs (See N65-16391 07-30)

The radiation effects of a high-altitude thermonuclear explosion were recorded by the Cosmos V on July 9, 1962 over Johnston Island. A flash of hard radiation was detected at the instant of explosion far beyond the limits of direct visibility, probably gamma radiation. In the first few minutes after the explosion, positively charged particles—protons, alpha particles, fission fragments, and positrons—were detected drifting toward the west. After 10 minutes, electrons with energies of several MeV became dominant. In the region magnetically conjugate to Johnston Island, at altitudes of about 500 km and close to the Brazilian magnetic anomaly at altitudes of 200 to 300 km, comparatively soft electrons were detected. E.E.B.

N65-16401 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE POSSIBILITY OF CAPTURING CHARGED PARTICLES IN THE FIELD OF A MAGNETIC DIPOLE IF ENERGY IS LOST AS A RESULT OF EMISSION

V. M. Vakhnin and I. N. Shvachunov *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 191–199 refs (See N65-16391 07-30)

The possibility of capturing charged particules in the field of a magnetic dipole, carried out earlier for plane (two-dimensional) motion, is extended to the case of an arbitrary three-dimensional particle motion. Use is made of a method of phase trajectories in a four-dimensional phase space. It is demonstrated that the "critical trajectories" and the possibility of capture exist in three-dimensional motion as well. Author

N65-16402 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPECTRUM OF VERY HIGH-ENERGY ELECTRONS ARISING IN THE β-DECAY OF THE ALBEDO NEUTRONS

A. I. Yershkovich *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 200–206 refs (See N65-16391 07-30)

The equilibrium integral spectrum of β-electrons in the case of energies of the order of several MeV is calculated. It is demonstrated that this spectrum agrees with the experimental results obtained in the area of the outer radiation zone. Author

N65-16406 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION CHARACTERISTICS OF ELECTRONS WITH ENERGIES AROUND 100 kev AT MODERATELY HIGH ALTITUDES ABOVE THE EARTH

V. V. Temnyy *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 258–261 refs (See N65-16391 07-30)

Examination of the positions of the experimental surfaces of equal electron intensity reveals that for intensities lower than 2×10^7 particles per square centimeter per second, as one moves towards the east in the direction of electron drift from lambda approximately zero to lambda of approximately 120 degrees of western longitude, the field strength increases progressively. As one moves further in the same direction, the field strength diminishes progressively from the maximum of lambda approximately 120 degrees of western longitude to a minimum at lambda approximately zero. Several possible explanations are given for this variation of equal intensity surfaces with longitude. E.E.B.

N65-16477*# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

MEASUREMENT OF SOLAR FLARE PRODUCED COSMIC RADIATION

dePaul J. Corkhill, Rudolf A. Hoffman, and Robert J. Lockhart Oct. 1962 77 p refs

(NASA Order R-12)

(NASA-CR-50114; ARL-TDR-62-24) OTS: HC $3.00/MF $0.75

To determine the intensity and energy spectrum of radiation in the atmosphere following a solar flare, an instrument package consisting of a scintillation telescope (for protons), low- and high-energy neutron detectors, and a shielded Geiger counter was designed and built. The system was carried to altitudes of 120 000 to 130 000 feet by polyethylene balloons on two occasions during July 1961. On a third flight, which took place during conditions of very high radiation in the atmosphere due to a solar flare, the balloon ruptured at 90 000 feet, so data were obtained on this flight for only a short time. A malfunction in the Geiger counter circuitry and in the power supply of the scintillation telescope rendered almost all these data unreliable. Useful data from the neutron detectors were obtained during the early hours of each flight and compared well with calculated spectrum curves. Author

N65-16480*# Princeton Univ. Observatory, N. J.

THE EFFECT OF LINE BLANKETING ON ULTRAVIOLET STELLAR RADIATION

Donald C. Morton [1964] 6 p refs

(Grant NsG-414)

(NASA-CR-53422) OTS: HC $1.00/MF $0.50

Detailed calculation of ultraviolet line profiles in B-star atmospheres are reported. The line absorption was calculated for the temperature-electron pressure distribution in each continuum model but no correction for line blanketing was made to the condition of constant flux. This correction could affect the models significantly, since results to be published shortly

for the whole ultraviolet line spectrum show a total absorption of about one-third the total continuum flux. The strong lines within the detector bandwidths are listed, along with the abundances of the elements by weight corrected for the oxygen–hydrogen ratio. Also listed are excitation potentials in wave numbers. E.E.B.

N65-16491*# California Univ., La Jolla.
THE POSITRON-ELECTRON RATIO OF PRECIPITATING ELECTRONS
Laurence E. Peterson [1963] 38 p refs
(Contract NASw-56; Grant NsG-318-63)
(NASA-CR-53791) OTS: HC $2.00/MF $0.50

A balloon observation of the X-ray spectrum from 37 to 700 KeV over Minneapolis during the July 1961 solar event series has allowed an upper limit to be placed on the ratio of positrons to electrons during a precipitation, as well as on other geophysical processes. The electrons caused the X-ray bursts; no large fluxes above cosmic-ray produced background were observed above approximately 400 KeV. The excess flux at 0.5 MeV, which would be caused by positrons annihilating was 0.051 $\pm$0.043 photons/cm^2-sec over a 68-minute interval at 2100 UT (1500 local) on July 13. No solar protons of energies greater than air cutoff (80 MeV) were observed during the flight. Author

N65-16600*# Consultants and Designers, Inc., Arlington, Va.
INTERACTION OF RAREFIED PLASMA FLUXES WITH THE MAGNETIC FIELDS OF COSMIC OBJECTS [O VZAIMODEYSTVII POTOKOV RAZREZHENNOY PLAZMY S MAGNITNYMI POLYAMI KOSMICHESKIKH OBYEKTOV]
Yu. S. Sigov. 11 Feb. 1965 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, 1964 p 948–951
(Contract NAS5-3760)
(NASA-TT-F-9642; ST-PP-GM-10292) OTS: HC $1.00/MF $0.50

The assumption of strict plasma neutrality in the boundary layer is used in the theoretical consideration of the structure of a boundary layer between the magnetic field of cosmic bodies, and the rarefied plasma. The neutral theory gives, for the nonrelativistic particle energies in the flux, the order of magnitude of boundary layer thickness and, in certain cases, the dependence of the field on coordinates. Some results of numerical solution of a stationary problem for a plane boundary layer structure are presented, and a detailed mathematical setup for such a problem is given. G.G.

N65-16654# Battelle Memorial Inst., Columbus, Ohio. Radiation Effects Information Center
THE SPACE-RADIATION ENVIRONMENT AND ITS INTERACTIONS WITH MATTER
E. R. Leach, B. P. Fairand, and L. H. Bettenhausen 15 Jan. 1965 103 p refs
(Contract AF 33(615)-1124)
(REIC-37)

Space-radiation data are summarized and evaluated. Radiation-measurement techniques are discussed, and the apparatus used on several American space probes and satellites is described. Particle flux as a function of type of radiation and energy is summarized in graphic form, and basic concepts of the interaction of space radiation with matter are discussed. Author

N65-16824# Rochester Univ., N. Y. Dept. of Physics and Astronomy
A NEW METHOD FOR THE ESTIMATION OF THE PRIMARY ENERGY OF COSMIC RAY JETS
M. L. Shen and M. F. Kaplon 12 Nov. 1964 95 p refs Submitted for Publication
(Contract AT(30-1)-875; Grant AF-AFOSR-439-63)
(URPA-63; AD-455836)

Methods of determining the primary energy of cosmic ray jets are reviewed, and the corrections which have been developed to improve the basic assumptions are discussed to clarify the limit of this applicability. To avoid the disadvantages inherent in the usual methods, a new method has been developed which is based mainly on the constancy of transverse momentum of the charged secondary shower particles and which is free of the usual assumptions employed. Nuclear interactions induced by 28.5-BeV protons and 17-BeV π^--mesons in emulsion have been analyzed to test the validity of this method, and the results are compared with those obtained using other methods; the agreement is much better with the new method. The half-widths of the γ_c (Lorentz factor of the center of mass system) distributions are greatly reduced and appear to be consistent with the assumption that they are mainly due to the Fermi momentum of the target nucleon in the target nuclei. Author

N65-16881# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.
THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC EMISSION AT 408 Mc/s Progress Report, Jul.–Sep. 1964
Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1964] 10 p refs
(Contract N62558-3928)
(PR-4; AD-608643)

Various observations and attempted observations of the occultation of radio stars by the moon are reported. A digitizer for encoding the output of the receiver–amplifier is described. A digital data logging machine of improved reliability is under construction, and high-latitude features are discussed in terms of the data describing them and possible explanations of their origins. The Spur and the Scorpio X-ray source are also briefly considered. D.E.W.

N65-16896 Boeing Co., Seattle, Wash.
FRACTIONAL CELL LETHALITY APPROACH TO SPACE RADIATION HAZARDS
S. B. Curtis, D. L. Dye, and W. R. Sheldon [1964] 11 p refs Presented at the 2d Symp. on Protection Against Radiations in Space, Gatlinburg, Tenn., Oct. 1964
(D2-90611; AD-608871)

A method of radiation hazard evaluation has been introduced in which the fractional number of inactivated cells of an organ is calculated. This fractional cell lethality (FCL) depends only on the particle energy spectrum and the probability of cell inactivation. Recent data on inactivation cross sections of human kidney cells have been used to calculate the contribution of protons, alpha particles, and M-group particles to the FCL of the kidney. The results indicate that the proton and alpha particle contributions would have been the same order of magnitude for the November 12, 1960 giant solar flare and their relative contribution does not vary much with shielding thickness. For a seated astronaut, the FCL values are on the order of 5% under reasonable shielding at points 4 and 6 cm inside the

body at the waist. When data on inactivation cross sections become available on more critical organs, containing cells not replaced by the body, this approach may yield a realistic evaluation of the hazard from high-LET radiation on extended space missions. Author

N65-17037# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research
MEASUREMENT OF SOLAR RADIO RADIATION AT 430 MEGACYCLES Quarterly Status Report, 1 Aug.–31 Oct. 1964
M. H. Cohen Nov. 1964 6 p
(Contract Nonr-401(27))
(CRSR-185; AD-608516)

An account is given of an experiment to determine the state of polarization radiated by the Arecibo Ionospheric Observatory antenna in both the main lobe and the first side lobe. Tentative results indicate that the axial ratios in both lobes are of the order of 4 to 8, and that the position angle of the polarization in one side lobe may be approximately 30° from the others. Because of the apparently independent fading of the two channels, great care must be taken not to get spurious results from the data. Preparations are described for polarization measurements of solar burst at 430 Mc. A new facet in the experiment is the determination of the power in the correlation signal by two phase-sensitive detectors. Their use should give an improved signal-to-noise ratio. R.L.K.

N65-17043# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
AN ATLAS OF VLF EMISSION SPECTRA OBSERVED WITH THE "HISS RECORDER"
Jean A. Koch and V. Christine Edens 13 Nov. 1964 32 p refs
(NBS-TN-226) GPO: $0.40

A compilation of electromagnetic hiss recorder sonagrams of very low, long-term, frequency emissions is presented extending individual emission data, previously published, to long-term group emissions. The atlas is organized into the following four sections: (1) emission events rising in frequency; (2) simultaneous observations at several locations; (3) simultaneous observations at conjugate points; and (4) long-period pulsations. G.G.

N65-17061*# Iowa State Univ., Iowa City.
RECENT OBSERVATIONS OF ELECTRON INTENSITIES IN THE EARTH'S OUTER MAGNETOSPHERE AND BEYOND
L. A. Frank, J. W. Freeman, Jr., and J. A. Van Allen [1963] 39 p refs Presented at the COSPAR Fourth Intern. Space Sci. Symp., Warsaw, Jun. 1963
(Grant NsG-233-62)
(NASA-CR-50462; SUI-63-19) OTS: HC $2.00/MF $0.50

A comprehensive study of the distribution of low-energy electrons in the outer portions of the earth's magnetosphere, in and near the geomagnetic equatorial plane, is being made by means of zero-wall-thickness CdS total energy flux detectors and thin-windowed (1.2 mg/cm^2 mica) Geiger–Mueller tubes on the long-lifetime satellites Explorers XII and XIV, whose geocentric apogee distances are 83 000 km and 105 000 km, respectively. Observations are now available within the outer magnetosphere, at its boundary and beyond; and over a wide range of sun-earth-probe angles from positions on the noon meridian to ones on the midnight meridian. Results of electron intensity measurements are reported. Author

N65-17064*# Iowa State Univ., Iowa City. Dept. of Physics and Astronomy
A SURVEY OF MAGNETOSPHERIC BOUNDARY PHENOMENA.
L. A. Frank and J. A. Van Allen Aug. 1963 64 p refs Presented at Symp. on Results of the IGY-IGC, Los Angeles
(Grant NsG-233-62)
(NASA-CR-51070; SUI-63-29) OTS: HC $3.00/MF $0.75

The flow of solar plasma around the earth profoundly affects the phenomena of the distant magnetosphere; these phenomena in turn may be intimately related to processes occurring near the earth's surface via the geomagnetic lines of force. The highlights of our rapidly expanding knowledge of the phenomena in the vicinity of the interaction between the solar wind and the distant geomagnetic field are reviewed. Author

N65-17115*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADIATION MEASUREMENTS ON THE NINTH MERCURY-ATLAS MISSION (MA-9)
Carlos S. Warren and Benny R. Baker Washington, NASA, Feb. 1965 30 p refs
(NASA-TN-D-2608) OTS: HC $2.00/MF $0.50

Measurements were taken during the MA-9 mission to establish the radiation received both inside and outside the spacecraft. The body dosage measured on the astronaut was measured by four film badges worn on the body and inside the helmet. Radiation levels within the spacecraft were measured by a nuclear emulsion pack placed behind the instrument panel and by an ionization chamber attached to the inside of the egress hatch cover. The exterior environment measurements were made by Geiger tubes mounted on the vehicle retrorocket package. Dose measurements on the film badges worn by the astronaut show that less than 12 to 14 milliroentgens, gamma equivalent body surface dose, were received from electrons and/or gamma rays. The exterior environment measurements recorded the decay of Starfish electrons to a level between 10% and 20% of the July 1962 value. This amount is considered safe at Mercury altitudes, even for extended missions. Author

N65-17279*# Michigan Univ., Ann Arbor. Radio Astronomy Observatory
COSMIC RADIO INTENSITIES AT 1.225 AND 2.0 MEGACYCLES/SEC MEASURED UP TO AN ALTITUDE OF 1700 KILOMETERS
D. Walsh, F. T. Haddock, and H. F. Schulte [1963] 37 p refs Presented at the COSPAR 6th Plenary Meeting and 4th Intern. Space Sci. Symp., Warsaw, Jun. 1963
(Contract NASw-54)
(NASA-CR-60780) OTS: HC $2.00/MF $0.50

A description is given of a rocket flight to 1700-km altitude for the purpose of measuring cosmic noise intensities at 0.75, 1.225, and 2.0 mc. Above the peak of the ionosphere, no signals originating on the bottomside were detected. Modulation of the radiometer outputs due to vehicle spin was observed throughout the trajectory. At the higher parts, this was unrelated to the ionosphere and was presumably due to nonuniformity of sky brightness. At lower altitudes, a series of ionospheric effects was observed, and is discussed in relation to impedance behavior of an antenna in a magnetoionic plasma. The disappearance of the extraordinary wave at the level $X = 1 - Y$ was detected and clearly identified by the sharp drop in signal and the enhanced angle-dependence of the radiation resistance. Previously unreported regions in the ionosphere

of high noise levels were detected, and the conditions for their occurrence in relation to propagation behavior in the ionosphere are delineated. The validity of semitheoretical corrections of cosmic noise measurements for the plasma influence on the antenna is demonstrated. Author

N65-17281*# Massachusetts Inst. of Tech., Cambridge.
RESULTS ON GAMMA-RAY ASTRONOMY FROM EXPLORER XI
G. W. Clark and W. L. Kraushaar [1964] 23 p
(Contract NASw-37)
(NASA-CR-60785) OTS: HC $1.00/MF $0.50

Experimental results are presented on gamma ray astronomy obtained from the Explorer XI satellite. The synchrotron tests showed that the instrument, the gamma ray detector-telescope, responded to gamma rays with an aperture cone of about a 17° half angle. In orbit the effect of the atmosphere producing albedo gamma rays can be clearly seen. These albedo observations are proof that the telescope was selectively sensitive to gamma rays in orbit. Furthermore, the measured intensity of albedo gamma rays is consistent with earlier balloon observations. The pulse height distributions obtained during calibration and with gamma ray logic are shown. During calibration a considerable fraction of the pulses are saturated from the effects of nuclear interactions and heavy primaries. Conclusive evidence that the 64 events observed were cosmic gamma rays may be provided by an observed anisotropy. Unfortunately, when the events observed are spread out on a celestial map it is not possible to draw any definite conclusion regarding their distribution. Taking into account the geometrical factor and the detection efficiency, the average intensity of gamma radiation was arrived at which is between 3 and 10 $\times 10^{-4} cm^{-2} sec^{-1} st^{-1}$. J.R.C.

N65-17317*# National Aeronautics and Space Administration, Washington, D.C.
SYMPOSIUM ON THERMAL RADIATION OF SOLIDS. SESSION IV: SPACE ENVIRONMENTAL EFFECTS
[1964] 142 p refs Preprint of papers presented at San Francisco, 4–6 Mar. 1964 Sponsored in cooperation with Aeron. Systems Div., USAF and NBS
(NASA-TM-X-54697) OTS: HC $4.00/MF $1.00

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N65-17318* Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
SOME FUNDAMENTAL ASPECTS OF NUCLEAR RADIATION EFFECTS IN SPACECRAFT THERMAL CONTROL MATERIALS
J. E. Gilligan and R. P. Caren *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] 21 p refs (See N65-17317 07-29) OTS: HC $4.00/MF $1.00
(Contract AF 04(695)-136)

The methods and results of an investigation to determine the mechanisms by which solar reflector thermal control systems degrade under individual and combined ultraviolet and nuclear radiations are described. Appropriate optical and radiation effects theory is compared with the published results of irradiation experiments, in which transparent analogs of certain dielectric and semiconductor pigments were studied. Conclusions were reached regarding the equivalence of uv and nuclear radiation effects, basic causes of induced reflectance changes, and possible means of limiting the degradation due to these radiations. Author

N65-17319* General Mills, Inc., Minneapolis, Minn. Electronics Div.
SOLAR-WIND BOMBARDMENT OF A SURFACE IN SPACE
G. K. Wehner *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] refs (See N65-17317 07-29) OTS: HC $4.00/MF $1.00
(Contract NASw-751)

With the goal of studying possible modifications of the lunar surface, measurements were performed with mass separated H^+, H_2^+, and H_3^+ beams, and in low pressure noble gas plasmas. The sputtering rates are rather small and amount to ~ one Å/year for Cu and ~ 0.5 Å/year for Fe, with many oxides roughly in the same range as that of Fe. Thus, the moon should have lost a layer of 17-cm thickness in 4.5×10^9 years or a 1-cm thick Cu plate would be sputtered away in approximately 10^8 years. Experiments with metal targets and metal-, oxide-, and rock-powder samples demonstrate the leveling and smoothing of macroscopic surface features, the etching of polished surfaces (because differently oriented grains have different sputtering rates), and the cementing together of loose particles into a porous, brittle, fibrous crust. E.P.V.

N65-17320* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
THE EFFECTS OF MICROMETEOROIDS ON THE EMITTANCE OF SOLIDS
Ronald B. Merrill *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] 29 p refs (See N65-17317 07-29) OTS: HC $4.00/MF $1.00

An analytical model is developed to predict the change in the emittance of a surface caused by particle impact. This model is applied in a representative fashion to determine the change in the emittance due to the space environment. Author

N65-17321* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL DEVELOPMENT OF A TECHNIQUE FOR THE CORRELATION OF FLIGHT- AND GROUND-BASED STUDIES OF THE ULTRAVIOLET DEGRADATION OF POLYMER FILMS
John A. Parker, Carr B. Neel, and Morton A. Golub (Stanford Res. Inst.) *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] 18 p refs (See N65-17317 07-29) OTS: HC $4.00/MF $1.00

To obtain the desired mechanical properties for a flight test, a surface consisting of a pure polyvinyl chloride terpolymer film (VMCH) was cast on a polished aluminum substrate. This material is found experimentally to behave almost identically to the pure polyvinyl chloride. Predicted temperature changes of such a surface will be compared with the actual results obtained by orbiting the surface on the S-57 OSO. The amount of gamma radiation required to produce a given change in the absorptance equivalent to that produced by a specific amount of ultraviolet radiation was determined experimentally. This paper discusses the research on the ground-based phase of this program. The results obtained will be correlated ultimately with an inflight test on the S-57 Orbiting Solar Observatory which should provide an evaluation of the simulation technique. Author

N65-17322* IIT Research Inst., Chicago, Ill.
ULTRAVIOLET IRRADIATION IN VACUUM OF WHITE SPACECRAFT COATINGS
G. A. Zerlaut, Y. Harada, and E. H. Tompkins *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] 52 p refs Prepared for JPL (See N65-17317 07-29) OTS: HC $4.00/MF $1.00
(Contract NAS7-100)

Investigations of stability of materials to simulated space conditions were conducted in conjunction with a developmental program of spacecraft thermal control coatings. Determination of spectral reflectance and solar absorptance before and after exposure showed that none of the materials studied is completely unaffected by ultraviolet irradiation in vacuum. However, zinc oxide and, to a lesser extent, zinc sulfide were found to be unusually stable white pigments, and formed relatively stable coatings when dispersed in pure potassium silicate or in experimental methyl silicone polymers. Exposure to 4200 equivalent sunhours ultraviolet radiation in vacuum resulted in solar absorptance increases of less than 0.02 for both an experimental silicone and a potassium silicate paint pigmented with zinc oxide. Author

N65-17323* Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE EFFECTS OF ULTRAVIOLET RADIATION ON LOW α_s/ϵ SURFACES
R. L. Olson, L. A. Mc Kellar, and J. V. Stewart *In* NASA, Washington Symp. on Thermal Radiation of Solids. Session IV: Space Environ. Effects [1964] 15 p (See N65-17317 07-29) OTS: HC $4.00/MF $1.00

The predominant source of natural environmental damage to spacecraft thermal control surfaces is solar ultraviolet energy. An experimental investigation of this damage is described. The primary purposes are the evaluation of candidate materials, and the prediction of operational behavior for selected materials. Candidate surfaces are exposed in vacuum to near-ultraviolet energy; the effect of these exposures on the materials' normal spectral reflectance is determined. The primary energy source is the A-H6 mercury–argon high-pressure lamp; this is used bare and with filters. Incident fluxes are determined with calibrated phototubes and with thermopiles. Sample ambient pressures are maintained at 10^{-6} to 10^{-7} torr; sample temperatures are varied from 70° to 500° F. Incident flux densities are varied tenfold. Both initial damage and damage reversibility (bleaching) are investigated. Efforts are concentrated on white pigment-vehicle binary systems; these are candidate low α_s/ϵ spacecraft surfaces. Results demonstrate the dependence of damage upon wavelength of irradiation and upon sample temperature. Materials studied include silicate, silicone, acrylic, and epoxy vehicles, and TiO_2, ZnO, $ZrSiO_4$, and $Li/Al/SiO_3$ pigments. Possible damage mechanisms are reviewed. Author

N65-17341# Colorado Univ., Boulder. Dept. of Astrophysics and Atmospheric Physics
THE POLARIZATION OF PROMINENCE HELIUM I D_3 EMISSION
Charles Latif Hyder (Ph.D. Thesis) 1964 145 p refs

The polarization of prominence emission in the HeI D_3 multiplet is derived as a function of the excitation temperature in D_3, the height of the prominence above the solar limb, and the prominence magnetic field. The analysis is by a perturbation treatment of the equations of statistical equilibrium. The theoretical results are compared with Lyot's observational results which restrict the ranges of excitation temperature and magnetic field. All of the effects observed by Lyot may be explained by the presence of a magnetic field of a filament that has been distorted by differential rotation of the solar atmosphere. It was found that the strengths of prominence magnetic fields may range between 0 and 200 gauss. Resonance polarization and impact polarization effects may be used to infer anisotropies and magnetic fields in other astronomical objects. The analysis is outlined and discussed. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-16391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH, VOLUME 2, NO. 5, 1964
L. I. Sedov, ed. 4 Nov. 1964 262 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 5, 1964 p 657–813 (FTD-TT-64-1077/1+2; AD-608083)

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15. DISTRIBUTION CHARACTERISTICS OF ELECTRONS WITH ENERGIES AROUND 100 keV AT MODERATELY HIGH ALTITUDES ABOVE THE EARTH V. V. Temnyy p 258–261 refs (See N65-16406 07-29)

N65-16392 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A STUDY OF THE OSCILLATION OF A SATELLITE IN THE PLANE OF AN ELLIPTICAL ORBIT

U. A. Zlatoustov, D. Ye. Okhotsimskiy, V. A. Sarychev, and A. P. Torzhevskiy *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 1–16 refs (See N65-16391 07-30)

Plane oscillations of a satellite, on an elliptical orbit under the influence of gravitational moments, are considered, and periodic solutions to the equation describing these oscillations are sought. The questions as to the number of periodic solutions and their stability are investigated as functions of the defining parameters—the eccentricity of the orbit and the inertia characteristics of the satellite. Author

N65-16393 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PERIODIC SOLUTIONS TO THE EQUATION OF PLANE OSCILLATIONS OF A SATELLITE ON AN ELLIPTICAL ORBIT

A. P. Torzhevskiy *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 17–34 refs (See N65-16391 07-30)

The existence and uniqueness of odd periodic solutions of period $2\pi k$ ($k = 1, 2, \ldots$) to the second-order nonlinear differential equation, describing plane oscillations of a satellite on an elliptical orbit, are discussed. The qualitative behavior of solutions with period 2π is considered as a function of parameter variation; and a differential equation is written for a parameter–plane branching (bifurcation) curve, the initial segment of which is constructed in explicit form. Author

N65-16394 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE CALCULATION OF TRAJECTORY FOR ENTRY INTO ATMOSPHERE

V. A. Yaroshevskiy *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 35–59 refs (See N65-16391 07-30)

An approximation equation for the motion of a space vehicle in the atmosphere is used to examine the influence of lift and initial velocity on atmosphere-entry trajectories. Atmosphere-entry trajectories of vehicles using lift, and atmosphere-entry trajectories with velocities greater than circular velocity are treated. The cases discussed are small lift-to-drag ratio, high lift-to-drag ratio, small angle of entry into the atmosphere, segment of first descent, rebound trajectory, atmosphere-immersion segment, atmosphere climbout segment, and atmosphere entry corridor for vehicles with lift. E.E.B.

N65-16395 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATING SPACE-VEHICLE TRANSFER TRAJECTORIES BETWEEN COPLANAR CIRCULAR ORBITS IN A NEWTONIAN GRAVITATIONAL FIELD

V. A. Il'in *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 60–82 refs (See N65-16391 07-30)

The sphere-of-influence method is used in examining the problem of determining space-vehicle trajectories of transfer between coplanar circular orbits in a Newtonian gravitational field. Simple relationships are derived between the eccentricities and focal parameters of single- and double-impulse transfer trajectories, which satisfy the condition of constancy of the transfer characteristic velocity or of the angle between the initial and final radius vectors. Examples are given in which the results obtained are used to solve problems of interorbital transfer and rendezvous of circumterrestrial spacecraft, and problems of interplanetary transfers. Author

N65-16396 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING *A PRIORI* ERROR ESTIMATES IN DETERMINING PARAMETERS BY THE METHOD OF LEAST SQUARES

M. L. Lidov *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 83–87 refs (See N65-16391 07-30)

The problem of minimizing the error in the determination of a given trajectory parameter (by selecting a certain battery of measurements from a given aggregate) is considered, with the assumption of the most unfavorable relationship between the measurement error correlation coefficients. The maximum probability method, or the method of least squares, is used to determine flight trajectory parameters from a given set of measurements. Author

N65-16397 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF V. V. RUMYANTSEV'S THEOREM OF STABILITY WITH RESPECT TO SOME OF THE VARIABLES IN PROBLEMS OF CELESTIAL MECHANICS

V. G. Demin *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 88–92 ref (See N65-16391 07-30)

Using V. V. Rumyantsev's theorem on stability with respect to some of the variables, the stability of the semimajor axes of the orbits of celestial bodies is demonstrated in those problems of celestial mechanics in which small perturbing functions are conservative in nature. Author

N65-16398 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE STABILITY OF SATELLITE ORBITS WITH CONSTANTLY OPERATING PERTURBATIONS

V. G. Demin *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 93–99 refs (See N65-16391 07-30)

The Kolmogorov–Arnold method is used to prove stability of planet–satellite orbits and the conditionally periodic nature of the motion. It is assumed that the satellite's motion is perturbed by constantly operative small forces of a conservative nature. Author

N65-16399 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS AND FUTURE PROSPECTS FOR INVESTIGATIONS OF COSMIC RAYS

N. L. Grigorov, I. D. Rapoport, I. A. Savenko, and G. A. Skuridin *In its* Cosmic Res., Vol. 2, No. 5, 1964 4 Nov. 1964 p 100–172 refs (See N65-16391 07-30)

The basic problems involved in the operation of an ionization calorimeter—an instrument used to measure the energy of cosmic-ray particles, and the relationship between the basic parameters of the ionization calorimeter and the conditions of its utilization—are considered. In addition, there is a consideration of the possibilities of employing an ionization calorimeter to study (1) a number of the characteristics of reactions between atomic nuclei and cosmic-ray particles exhibiting energies of $10^{11}-10^{13}$ eV, (2) the composition of high-energy primary cosmic-ray particles ($10^{11}-10^{14}$ eV), (3) the electron component of primary cosmic rays, and (4) high-energy γ-radiation. Author

N65-16441# Air Force Systems Command, Inglewood, Calif. Systems Engineering Div.

AN ANNOTATED BIBLIOGRAPHY OF SPACE VEHICLE REENTRY AND ASSOCIATED PHENOMENA Technical Documentary Report, Jan. 1956–Mar. 1963

R. H. Schorsch, comp. Oct. 1963 461 p

(SSD-TDR-63-389; AD-427564)

This annotated bibliography results from an extensive literature survey of the theory and physical phenomenon associated with the reentry of space vehicles, and related information such as the interaction of electromagnetic waves with the hypersonically generated ionized sheath, techniques of reentry trajectory analysis and optimization, structural and material considerations, and many others. Only a limited number of references pertaining to specific reentry projects, such as the Mercury and Dyna-Soar Programs, are included. Literature surveyed covers the time period from January 1956 through March 1963, comprising 1150 references which are listed alphabetically by author or by originating agency if the author is unknown. The Armed Services Technical Information Agency (ASTIA) document numbers are also included, when available, to facilitate ordering. Author

N65-16448*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PARAMETRIC PERFORMANCE ANALYSIS FOR LUNAR ORBIT BRAKING AND DESCENT

Charles M. Akridge and Sam H. Harlin Washington, NASA, Feb. 1965 74 p refs

(NASA-TN-D-2643) OTS: HC $3.00/MF $0.75

The effects of thrust-to-weight ratio, specific impulse, and altitude on trajectory parameters have been investigated for braking to lunar orbit, and descent to the lunar surface from this lunar parking orbit. A single stage with constant thrust directed against the velocity vector was used in all instances. Specific impulses of 300 and 420 seconds and earth-to-moon transfer times for braking of 50, 60, and 72 hours were used for compensation. The results of the study show the variations of the braking trajectory parameters for earth thrust-to-weight ratios from 0.1 to 1.0. The descent variations are limited to earth thrust-to-weight ratios from 0.2 to 0.5. These parameters include true anomaly, change in altitude, flight path angle, range angle during thrusting, burning time, characteristic velocity, propellant fraction, and velocity losses. Author

N65-16463# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPACE Collection of Articles

V. I. Krasovskiy, ed. 3 Sep. 1964 102 p Transl. into ENGLISH of Kosmos (Moscow), no. 1, 1963 p 1–96

(FTD-MT-64-239; AD-608184)

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5. STUDY OF INTERPLANETARY GAS AND IONOSPHERES OF PLANETS WITH THE HELP OF TRAPS OF CHARGED PARTICLES K. I. Gringauz p 86–97 (See N65-16468 07-30)

N65-16465 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CREATION OF HABITABLE MEDIUM IN FUTURE SPACE FLIGHTS OF MAN

A. A. Nichiporovich *In its* Space 3 Sep. 1964 p 30–59 (See N65-16463 07-30)

The necessity to create and maintain a friendly environment so that future space travelers can survive on the Moon, Mars, or Venus is studied with emphasis on the oxygen–carbon dioxide exchange regulation; the physical and chemical water regeneration in a spaceship; green plants for generation of air; the selection of algae, higher plants, and animals to create a microcosm in cosmic space; the liquidation of waste, the binding of gaseous nitrogen blue–green algae or direct oxidation in an electric arc discharge; and the photosynthesis of algae and higher plants by the continuous supply of light. G.G.

N65-16466 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ASTRONAUTICS AND EXTRATERRESTRIAL CIVILIZATIONS

V. I. Krasovskiy *In its* Space 3 Sep. 1964 p 60–81 (See N65-16463 07-30)

The plurality of life in the universe is considered. Contemporary data on the physicochemical states of planets in the solar system do not substantiate the existence of animal life on these planets and seem to exclude all vegetable life with the exception of Mars. A primitive vegetation like lichens or any microorganism could be found on the Martian surface. The time interval between sending a cosmonaut into far stellar worlds and his return can be so great that his actual return to Earth will lose meaning. G.G.

N65-16467 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF INTERSTELLAR COMMUNICATION

G. Kokkoni and F. Morrison *In its* Space 3 Sep. 1964 p 82–85 (See N65-16463 07-30)

The possibility of communication with civilizations in other solar systems is considered. Interstellar communications through a galactic medium without losses are only possible with the help of electromagnetic oscillations in the frequency range from 1 to 10000 Mc, possible on the line of neutral hydrogen radiation at 1420 Mc. Reports should be transmitted for several years because no answer can be expected earlier than several decades, and the first attempts should be directed to the inspection of stars at a distance of 15 light years from earth with a luminosity and lifetime similar to our sun. G.G.

N65-16468 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY OF INTERPLANETARY GAS AND IONOSPHERES OF PLANETS WITH THE HELP OF TRAPS OF CHARGED PARTICLES

K. I. Gringauz *In its* Space 3 Sep. 1964 p 86–97 (See N65-16463 07-30)

Three electrode traps were established on all Soviet space rockets to catch charged particles in order to study the interplanetary plasma. Experiments with these traps led to the conclusion that the free electrons of stationary interplanetary gas did not influence the accuracy of radio navigation in space because their concentration is too small; however, the concentration of charged particles in solar corpuscular fluxes was found to be larger than in stationary plasmas. Studies of the earth ionosphere revealed the existence of electron streams at distances of 55000 to 75000 km from the earth's surface with densities of 10^8 cm^{-2} sec^{-1} and of more than 200 eV energies. It is assumed that the most external belt of charged particles with its boundaries along the lines of force of the geomagnetic field of the earth consists of particles with less energy that those in the radiation belts. G.G.

N65-16475*# California Univ., Berkeley. Space Sciences Lab.

CONSOLIDATED QUARTERLY PROGRESS REPORT, PERIOD ENDING FEBRUARY 1, 1964

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(NASA-CR-53542) OTS: HC $3.00/MF $0.75

Current research projects under grants from ONR, NSF, CGS, AFOSR, and NASA concern radio astronomy, geophysics, ionospheric studies, propulsion dynamics, detection and study of microorganisms in the upper atmosphere, porous electrode systems, sensory deprivation, satellite hardware, control and information systems, space bioscience, RNA, fluid mechanics, thermodynamics, heat transfer, physical and engineering sciences, and social studies for research and development projects. R.L.K.

N65-16498*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

MARS-VENUS CAPSULE PARAMETER STUDY. VOLUME I: INTRODUCTION AND ANALYSIS

21 Mar. 1964 290 p refs Prepared for JPL

(Contract JPL-950626)

(NASA-CR-53674; RAD-TR-64-1, Vol. I, Rev. I) OTS: HC $6.00/MF $1.50

Partial results are presented of 6-month study that was undertaken to obtain comprehensive information to be used in the design, performance, and environment studies of Mars and Venus entry capsules. By approximate methods, computer routines were compacted, computer calculation time was reduced, and the ability to deal with a broad scope of parameters was enhanced. The objectives of the studies of shapes, elemental weights, and residual weight are described. The scope of the overall work is discussed in terms of the Mars vehicle and the Venus vehicle. The computer program is described by blocks, and empirical data are treated by subject as well as by source. Analytical methods are discussed in detail, with special attention given to the coefficients block, the heating block, the trajectory block, the structure block, and the heat shield block. D.E.W.

N65-16510# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM PRIRODA (NATURE), VOL. 53, NO. 11, 1964

25 Jan. 1965 39 p Transl. into ENGLISH of 3 Articles from Priroda (Moscow), v. 53, no. 11, Nov. 1964 p 2–9, 34–44, 111–112

(JPRS-28435; TT-65-30192) OTS: $2.00

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N65-16511 Joint Publications Research Service, Washington, D. C.

A NEW STAGE IN THE CONQUEST OF OUTER SPACE: PRESS CONFERENCE DEVOTED TO THE FLIGHT OF THE SPACE SHIP "VOSKHOD"

In its Transl. from Priroda (Nature), Vol. 53, No. 11, 1964 25 Jan. 1965 p 1–15 (See N65-16510 07-30) OTS: $2.00

The Vostok and Voskhod spacecraft are described and compared. The flight of the Voskhod on October 12, 1964, is narrated by each of the three occupants of the spacecraft on the flight. They discussed launch preparations, crew training, the work program during flight, atmospheric phenomena viewed from the spacecraft, visual observations of the aurora australis, events of the flight, flight objectives, kinesthetic illusions, food and appetites, physiological effects, and biotelemetry. D.E.W.

N65-16512 Joint Publications Research Service, Washington, D. C.

FINITENESS AND INFINITY IN THE UNIVERSE

E. Kol'man *In its* Transl. from Priroda (Nature), Vol. 53, No. 11, 1964 25 Jan. 1965 p 16-33 (See N65-16510 07-30) OTS: $2.00

A philosophical and ideological discussion is given of the relative merits, utility, and validity of a scientific view of life and the universe, of a religious view, and of an agnostic view. The scientific view is equated with Marxism–Leninism. Various developments in the history of science are mentioned that occurred between the time of Democritus and the present era, including, for example, the statement of the special and general theories of relativity. Lenin's views on space and time; the problem of time; the concept of infinity; the viewpoint of religion; and atheistic education are mentioned. D.E.W.

N65-16526# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF MOTION OF ARTIFICIAL CELESTIAL BODIES [PROBLEMY DVIZHENIYA ISKUSSTVENNYKH NEBESNYKH TEL]

7 Aug. 1964 340 p refs Transl. into ENGLISH of the publ. "Problemy Dvizheniya Iskusstvennykh Nebesnykh Tel" Moscow, Izd. Akad. Nauk SSSR, 1963 p 1–294 Rept. of the Conf. on Gen. and Appl. Probl. of Theoret. Astronomy, Moscow, 20–25 Nov. 1961

(FTD-MT-64-226; AD-608295)

Conference reports on qualitative questions of celestial mechanics, problems of motion of artificial earth satellites, numerical methods of celestial mechanics, definition of orbits, and questions on translational-rotary motion and attraction of celestial bodies. For individual titles see N65-16527–N65-16550.

N65-16527 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SMALL DENOMINATORS AND PROBLEM OF STABILITY IN CLASSICAL AND CELESTIAL MECHANICS

V.I. Arnol'd *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 6–18 refs (See N65-16526 07-30)

Results and methods are presented of recent research on the resolution of differential equations of dynamics in an infinite interval of time. A method of treating perturbation theory series which diverge because of small denominators is described; the method is applied to a series expressing conditionally periodic motion on the surface of a torus. A variant of Newton's method is presented to detect, by convergent consecutive approximations, conditionally periodic motions in the general problem of perturbation theory. Three cases of degeneration encountered in problems of celestial mechanics are discussed. D.S.G.

N65-16528 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT INSTABILITY OF PERIODIC SOLUTION OF CANONICAL SYSTEM WITH ONE DEGREE OF FREEDOM IN CASE OF MAIN RESONANCE

G. A. Merman *In its* Probl. of Motion of Artifical Celestial Bodies 7 Aug. 1964 p 19–41 refs (See N65-16526 07-30)

The question about stability of periodic solutions of a canonical system with one degree of freedom (with analytic right parts) reduces to the investigation of stability of the following system of differential equations:

$$dx/d\tau = \partial H/\partial y,\ dy/d\tau = -\partial H/\partial x,$$

where

$$H = 1/2\lambda(x^2 + y^2) + \sum_{m+n=3}^{\infty} A^{(m,n)}(\tau)x^m y^n,\ A^{(m,n)}(\tau + \omega) = A^{(m,n)}(\tau),\ \pm\lambda i$$

are characteristic indices of solution, and ω is its period. In particular, this pertains to periodic solutions of a flat restricted three-body problem, different from points of libration. It is shown that, in the presence of main resonance, motion will be always unstable without any restrictions. D.S.G.

N65-16529 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON EVOLUTION OF PLANET SYSTEMS

A. M. Molchanov *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 42–50 (See N65-16526 07-30)

Equations are derived that describe slow variation of parameters of orbits. It is clarified that flat circular orbits are stationary (in the main member). This suggests that even a nonplanar system in the beginning has to become flat in the process of evolution. Dissipative factors necessary for evolution are not formally contained in equations of celestial mechanics. Here help is given by the following consideration. In the frames of celestial mechanics, disintegration of a system is possible when part of the planet system passes on hyperbolic orbits and leaves the system. Thus, the possibility of evolution, at the expense of disintegration, is already concluded in equations of celestial mechanics. It is necessary also to consider that for long times even small dissipative factors (for instance, tidal phenomena on sun) can play an essential role. Author

N65-16530 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FINAL MOTIONS IN A THREE-BODY PROBLEM

V. M. Alekseyev *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 51–68 refs (See N65-16526 07-30)

The basic aims of the qualitative analysis of the three-body problem are: a study of existence of periodic and conditionally periodic solutions of various forms; a study of the behavior of solutions during paired and multiple collisions and close passages; and a study of final types of motions, i.e., a study of the behavior of solutions as time approaches infinity. A survey of results attained is presented, and the difficulties encountered are discussed. The basic types of final motion considered are hyperbolic, hyperbolic–elliptic, restricted, oscillatory, hyperpolic–parabolic, and parabolic–elliptic motion. D.S.G.

N65-16531 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ORBITS OF ARBITRARY INCLINATION IN A RESTRICTED THREE-BODY PROBLEM

Ye. P. Aksenov *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 69–79 refs (See N65-16526 07-30)

The existence of periodic orbits of arbitrary inclination is proved, and approximate formulas for coordinates of the material point moving on such orbits are presented. The problem is formulated with an analysis of the perturbation function, the transformation of the differential equations of motion is described, and a proof is given for the existence of periodic solutions of the derived system of equations. D.S.G.

N65-16532 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXACT SOLUTION OF PROBLEM ABOUT MOTION OF ARTIFICIAL SATELLITE IN NORMAL GRAVITATIONAL FIELD OF EARTH

M. D. Kislik *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 81–96 refs (See N65-16526 07-30)

Resolution of the problem involving motion of a satellite in a normal gravitational field may be obtained using canonical equations of motion in Hamiltonian form in the inertial system of coordinates. As canonical variables, coordinates q_1, q_2, and q_3, and corresponding to them, the generalized impulses p_1, p_2, and p_3 are used. Integration of the system is done using Jacobi's method—detection of the complete integral of the partial differential equations in which the unknown is the characteristic function. Final integrals of equations of motion of the satellites can then be determined. The results of this analysis essentially supplement the qualitative perturbation theory of orbits of artificial satellites under the influence of flattening of the earth. D.S.G.

N65-16533 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF GENERALIZED PROBLEM OF TWO FIXED CENTERS IN THE THEORY OF MOTION OF ARTIFICIAL EARTH SATELLITES

Ye. P. Aksenov, Ye. A. Grebenikov, and V. G. Demin *In its* Probl. of Motion of Artifical Celestial Bodies 7 Aug. 1964 p 97–103 refs (See N65-16526 07-30)

In a previous paper, it was shown that the force function of the problem of two fixed centers could well approximate the potential attraction of earth if a certain imaginery value is taken as the distance between the two attracting centers. In this paper, only the case where the force function is real is considered. The classical problem of two fixed centers consists in the study of motion of a passively gravitating material point under the attraction of two active fixed material points P_1 and P_2. A rectangular system of coordinates Oxyz is selected with the the origin in the center of masses of points P_1 and P_2 so that the axis Oz coincides with straight line P_1P_2. The equations of motion and the force function are presented such that all constants (the masses M_1 and M_2 of the points, and their distances to the origin a_1 and a_2) are real, and formulas for the potential of terrestrial gravitation are derived. D.S.G.

N65-16534 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CLASSIFICATION OF LIMITED MOTIONS OF ARTIFICIAL CELESTIAL BODIES

Ye. N. Aksenov, Ye. A. Grebenikov, and V. G. Demin *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 104–112 refs (See N65-16526 07-30)

Presented is an analysis of the forms of motion of artificial earth satellites whose orbits are located wholly outside the limits of the earth's atmosphere. Solutions are given for the system of first integrals of differential equations of motion in spherical coordinates λ, μ, ω, in the form:

$$\left(\frac{d\mu}{d\tau}\right)^2 = 2h\mu^4 + 2(C_2 - h)\mu^2 - (2C_2 + C_1^2). \quad (1)$$

$$\left(\frac{d\lambda}{d\tau}\right)^2 = -2h\lambda^4 - \frac{2fM}{c^3}\lambda^3 + 2(C_2 - h)\lambda^2 - \frac{2fM}{c^3}\lambda + (2C_2 + C_1^2). \quad (2)$$

$$\left(\frac{d\omega}{d\tau}\right)^2 = \frac{C_1(\lambda^2 + \mu^2)}{(1 + \lambda^2)(1 - \mu^2)}. \quad (3)$$

In equations (1 to 3) τ is a regularizing independent variable, connected with time t by relationship $dt = (\lambda^2 + \mu^2)\, d\tau$; and C_1, C_2 and h are arbitrary constants, where h constitutes the constant of the integral of kinetic energies numerically equal to total mechanical energy of satellite, taken with opposite sign and referred to mass units. D.S.G.

N65-16535 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MOTION OF CLOSE ARTIFICIAL SATELLITES

Y. Kozai *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 113–126 refs (See N65-16526 07-30)

Theories of motion considering terms of the first order with respect to the flattening of the earth, and augmented by consideration of the effect of deceleration in the atmosphere, permit prediction of geocentric positions of satellites with an accuracy of 10 seconds of arc. Observations of satellites have been made with an accuracy of 3 seconds of arc. In order to increase the accuracy of the predictions, periodic perturbations of the second order, lunisolar perturbations, and periodic perturbations caused by atmospheric drag are considered, and analytic expressions for these effects are obtained. D.S.G.

N65-16536 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE ANALYSIS OF EVOLUTION OF ORBITS OF ARTIFICIAL SATELLITES

M. L. Lidov *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 127–141 refs (See N65-16526 07-30)

For many practical problems connected with artificial satellites, high accuracy is not required to obtain appraisal of the change of elements of orbits in a restricted interval of time. This permits the use of approximate equations for a broad class of orbits. If the changes of elements in one revolution are sufficiently small, then, for qualitative appraisals, the scheme of independent double averaging of perturbing accelerations with respect to average motion of the satellite itself and average motion of the perturbing body is practical. The change of elements of the satellite orbit during the averaging interval is not considered in the first approximation. The detailed study of approximate averaged equations is presented. D.S.G.

N65-16537 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYSIS OF ORBITS OF SATELLITES FOR GEODESIC PURPOSES

W. M. Kaula *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 142–152 refs (See N65-16526 07-30)

Difficulty of exact determination of positions of tracking stations and variations of earth's gravitational field from orbits of close satellites is discussed. Attempts to solve problems due to nonuniform distribution of observations, imperfection of the mathematical model of the atmosphere, large quantity of required calculations, and bad stipulation, i.e., different parameters rendering almost identical influence on the orbit, are described. It is shown that any analysis of changes of orbits of satellites for detecting geodesic effects will not give good results until an exact solution for the gravitational harmonic U_2^1 is obtained; it should be practically equal to zero according to observations of variations of latitude. D.S.G.

N65-16538 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF GRAVITATIONAL ANOMALIES OF EARTH ON MOTION OF ARTIFICIAL SATELLITES

V. F. Proskupin and N. G. Kochina *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 153–160 refs (See N65-16526 07-30)

In order to determine the influence of separate gravitational anomalies of the earth, or harmonics of its potential, on satellite motion, an expression for the potential of terrestrial attraction is transformed from a spherical mobile system of coordinates to a rectangular fixed system with its origin at the earth's center, and the equation of motion of the satellite is obtained:

$$d^2x/dt^2 - \delta U_0/\delta x = \delta U/\delta x$$

For study of the influence of each harmonic of the potential in either of two given orbits, 24 variants were considered, differing from each other in varied expressions of δU. The first or basic variant, where $\delta U/\delta x = 0$, takes into account elliptic motion and the first degree of oblateness. The basic variant plus one of the 22 components of the potential function form the next variants. The final variant is obtained by integration of the system without disregarding any term of the potential. Graphs of certain of the elements are presented. D.S.G.

N65-16539 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONVERGENCE TO SOLUTIONS OF SERIES OF CELESTIAL MECHANICS, OBTAINED BY NUMERICAL METHODS

J. Kovalevskiy *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 162–167 (See N65-16526 07-30)

The basis for numerical methods and procedures for numerical solutions in problems in celestial mechanics are discussed. An application of the method of numerical analysis is given for the especially difficult problem of the VIII satellite of Jupiter, where the method yielded good results. This method consisted of numerical integration of the actual problem or one very close to it, with complete accounting for perturbations of the sun on the assumption that Jupiter moves on an ellipse, and disregarding perturbations of other planets. Harmonic analysis was made of the obtained results, which were in the form of tables of values of the elliptic elements. Calculations which take into account the effect of the perturbations of Saturn are discussed, but results are incomplete. D.S.G.

N65-16540 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ESTIMATION OF ERROR OF NUMERICAL METHODS OF INTEGRATION OF EQUATIONS OF CELESTIAL MECHANICS

V. F. Myachin *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 168–185 refs (See N65-16526 07-30)

In order to develop standard programs that would permit machine calculation of errors either parallel to or after the numerical integration of systems of differential equations, a general method of estimating error is constructed and applied to equations in celestial mechanics. All sources of error (errors due to rounding, truncation, iteration, or initial data) are considered equally and uniformly. It is shown that with a large number of integration steps, k, the error, Δ, in coordinates of elliptic, hyperbolic, and parabolic motions obeys the asymptotic formula $\Delta = a\,k^{3/2}$, where a is the coefficient for the corresponding type of motion. Comparison of the linearized estimate with the precise estimate, and also with the true magnitude of error, shows that the obtained errors are not greatly overestimated and that the method of estimation has practical value. D.S.G.

N65-16541 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE ACCURACY OF THE EPHEMERIDES OF INNER PLANETS, PUBLISHED IN ASTRONOMICAL YEARBOOKS

D. K. Kulikov and N. S. Subbotin *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 186–200 refs (See N65-16526 07-30)

In connection with the increase of requirements for accuracy of astronomical ephemerides, a preliminary appraisal is made of the accuracy of ephemerides of the inner planets, published in astronomical yearbooks, on the basis of Newcomb's theory. Basic sources of errors in determination of coordinates of planets are those occurring during construction of analytic theories, assumptions of masses of planets, determination of elements of orbits, and determination of ephemerides of time. The influence of each of these sources of errors on heliocentric positions of planets is considered where the vector of errors is expanded into three components with respect to radius vector (ρ), the normal to plane of orbit (s) and the perpendicular to radius vector, lying in plane of orbit (τ). Vector components of errors are usefully expressed in astronomical units of length. Author

N65-16542 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF HIGH-SPEED COMPUTERS TO CONSTRUCTION OF ANALYTIC THEORIES OF MOTION OF PLANETS AND SATELLITES

N. G. Nolozova and V. A. Shor *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 201–209 refs (See N65-16526 07-30)

Analytic methods of calculation of perturbations permit the presentation of the coordinates of a body in the form of infinite trigonometric series whose arguments are functions of time, and present advantages over the method of numerical integration. Studies were conducted to develop such methods of calculation on high-speed computers. For calculation of absolute perturbations of small planets, a method is discussed in which the independent variable is the true anomaly of the perturbed planets, and the perturbations are of the first order and do not depend on constants of integration. Formulas are presented for the perturbations of radius vector, of longitude in orbit, and of latitude with reference to the plane of orbit. Derivatives of the perturbational functions with respect to coordinates are expanded into trigonometric series with respect to two arguments: (1) the true anomaly and (2) the angle which depends on the position of the perturbing planet and therefore may be expressed as a function of the true anomaly. After the expansion in series is carried out, the calculation of perturbations is reduced to multiplication, addition, subtraction, and integration; a program was developed for carrying out these operations on a computer and applied to the calculation of first-order perturbations of Ceres from Saturn. D.S.G.

N65-16543 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF ORBIT BY TWO POSITIONS

P. Ye. El'yasberg *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 211–223 ref (See N65-16526 07-30)

Determination of an unperturbed orbit of an object in outer space by two given positions is fully justified in the case of natural celestial bodies for which the fact of existence of the orbit is not in doubt and its type (elliptic, parabolic, hyperbolic, or vertical) can easily be determined. However, in the case of orbits of artificial satellites, questions of existence and uniqueness (ambiguity) arise. In the formulation of the problem, an object is considered to be moving in an unperturbed orbit in a central field of forces; its acceleration g directed to the attracting center is determined by $-g = \mu/r^2$, where μ is a certain coefficient and r is the distance from the object to the

attracting center. Assuming values of the radius vectors r_1 and r_2 are known for points D_1 and D_2 of the orbit at times t_1 and t_2, the problem of determination of orbit is reduced to the solution of two vector (or six scalar) equations of the form

$$r(q_1, q_2, \ldots q_6, t_1) = r_1$$
$$r(q_1, q_2, \ldots q_6, t_2) = r_2$$

where q_i ($i = 1, 2, \ldots 6$) refers to the six elements of orbit that determine its type. All possibilities of solution of this system of transcendental equations are considered. D.S.G.

N65-16544 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF DETERMINATION OF ORBITS OF ARTIFICIAL EARTH SATELLITES FROM MEASUREMENTS OF THE DOPPLER EFFECT

K. H. Schmidt *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 224–232 ref (See N65-16526 07-30)

To obtain the elements of the orbit of the third Sputnik and their change with time, measurements were made of the doppler effect of signals from the satellite during its near passages. The tangent at the point of bend of the doppler curve at the corresponding moment of time was used as the observation data. Maximum error in the determination of the tangent was 4%, and of the moment of time, about 3%. Methods of approximation were developed to determine the elements of orbit; these methods differed from those previously used in that the inclination of the orbit was not assumed but was determined from the observations. A detailed description of the method is presented. D.S.G.

N65-16545 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON A TABLE OF TRAJECTORIES OF FLIGHT TO VENUS

Ye. P. Aksenov, Ye. A. Grebenikov, V. G. Demin, and Ye. N. Pirogov *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 233–238 ref (See N65-16526 07-30)

A special table of approximate initial data and elements of orbits of interplanetary flight is described that was constructed on the basis of consideration of motion of the spaceship in the Newtonian field of attraction of the Sun. This table contains nearly 550 unperturbed trajectories of flight from Earth to Venus. In the calculations, it was assumed that Venus and Earth move in circular orbits in the plane of the ecliptic. Elements of the elliptic orbit (a, e, ω), heliocentric velocity of the spaceship at the initial moment, its direction, the geocentric velocity of the ship, its direction, and the relative location of Venus and Earth at the initial moment, are given in the table. This table may be used not only for tentative selection of orbits of flight and approximate initial data, but also for calculation of exact trajectories of flight. A series of trajectories of close passage near Venus were calculated with direct use of tabular initial data during integration of differential equations of perturbed motion. The results of one calculated trajectory are presented together with a description of the method used. D.S.G.

N65-16546 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS ON ARTIFICIAL SATELLITE MOTION RELATIVE TO CENTER OF MASS

V. V. Beletskiy *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 240–252 refs (See N65-16526 07-30)

Satellite motion relative to center of mass is divided into two basic types: (1) If the kinetic energy is low compared to the operation of external forces, then librational motion (satellite oscillation near the position of relative equilibrium in the system of coordinates) is connected with the radius vector of orbit. Such motion is caused by the stabilizing action of moments of gravitational forces. (2) If the kinetic energy is great compared to the operation of external forces, motion during a short interval of time will be almost undisturbed. Only slight perturbations are introduced into the motion, and these are of secular character. The effects of a number of basic factors on both types of satellite motion are discussed; these factors include gravitational moments, aerodynamic moments, influence of evolution of the satellite orbit, dissipative effects connected with atmospheric friction, and interaction of the satellite's magnetic field with the earth's magnetic field. D.S.G.

N65-16547 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE PRESENCE OF COMPLETE INFORMATION (GEOPHYSICAL, GRAVITATIONAL AND GEOMAGNETIC DATA) FOR EQUATIONS OF MOTION OF ARTIFICIAL EARTH SATELLITES

E. Tengstrom *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 253–260 refs (See N65-16526 07-30)

Expressions for the description of satellite orbit and motion are given which were derived considering conservative forces only and disregarding relativistic effects. It is proposed that, if variations of osculating elements of satellite motion could be exactly determined from observations, then the differences between those determinations and the gravitational terms of the derived expressions would determine the effects of nonconservative forces only. This separation of conservative and nonconservative effects involves a basic problem of geodesy; the solution includes obtaining values of the earth's mass, the geocentric coordinates of the surface, and the gravitational potential at any point in space. The methods for determining these values and the necessity of international cooperation in this problem is discussed. D.S.G.

N65-16548 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON PERTURBATIONS IN TRANSLATIONAL ROTARY MOTION OF TWO CELESTIAL BODIES

V. T. Kondurar' *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 261–283 refs (See N65-16526 07-30)

The problem of translational rotary motion of two rigid bodies for which the ellipsoids of inertia are different than for a sphere is considered. The solution is yielded in the first approximation, and is based on the series expansion parameter method. As parameters, dynamic compressions of bodies are used; and as unperturbed motion of the center of mass of an attracted body—its Keplerian motion (elliptic or hyperbolic). When compressions of bodies are equal to zero, then the inertial ellipsoid of the bodies becomes a sphere, and therefore, translational rotation of the bodies can be composed of three independent motions: one translational and two rotary. In this case, the system of differential equations of the problem is split into three separate systems, each of which is integrated in elementary functions and has three degrees of freedom. Author

N65-16549 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE FORCE FUNCTION OF ATTRACTION OF A PLANET AND ITS SATELLITE

M. S. Yarov- Yarovoi *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 284–303 refs (See N65-16526 07-30)

Solutions to the following problems are considered: (1) Regarding the second partial derivatives of the force function with respect to the three Euler angles, it is unknown whether there exists an equation analogous to the Poisson equation connecting these derivatives. (2) In the same way, it is unknown whether the force function of mutual attraction of two bodies T_1 and T_2 satisfies some equation when these bodies have common part T. (3) The presentation of solid body potential in the form of a system of a finite set of material points is considered as an approach to the study of the force function of attraction of two bodies. D.S.G.

N65-16550 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON TRANSLATIONAL ROTARY MOTION OF A COSMIC BODY RELATIVE TO THE EARTH

N. G. Magnaradze *In its* Probl. of Motion of Artificial Celestial Bodies 7 Aug. 1964 p 304–317 refs (See N65-16526 07-30)

A system of differential equations of translational rotation of a cosmic body relative to the earth, in the form of power series with respect to time, is solved. The earth is considered a sphere, uniform or having spherical distribution of densities, surrounded by a resisting medium (air), and attracting, according to Newtonian law, a body of a rod-like shape and variable mass. Using recent research, a system of differential equations of translational rotation of a body relative to the earth was derived. Proceeding from this system, for the coordinates of center of mass of a body and for its Euler angles, power series with respect to time were constructed, and their convergence was proved for a sufficiently small interval of time. At the expense of increasing the number of unknowns and corresponding equations for coefficients of these power series recurrent relationships, sufficiently convenient for calculation by contemporary computers, were obtained. A diagram was used, which is a generalization of the diagram recently proposed for solution of a limited problem of three-bodies (material points) with constant masses. Author

N65-16580*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

SIMULATOR STUDY OF ABILITY OF PILOTS TO ESTABLISH NEAR-CIRCULAR LUNAR ORBITS USING SIMPLIFIED GUIDANCE TECHNIQUES

G. Kimball Miller, Jr. and Herman S. Fletcher Washington, NASA, Feb. 1965 42 p refs

(NASA-TN-D-2631) OTS: HC $2.00/MF $0.50

A study was made with a six-degree-of-freedom fixed-base simulator of the ability of pilots to establish 486 000-ft (80-n. mi.) circular orbits about the moon using a simplified guidance technique. The pilot had control of thrust along the longitudinal axis and of vehicle attitude through an acceleration command system. No automatic damping or control was assumed. The general guidance procedure consisted of maintaining a constant thrust angle with respect to the lunar horizon until attaining the proper altitude with zero radial velocity. A constant-altitude deceleration maneuver was then performed to attain the proper circumferential velocity. Initially, a nominal trajectory was flown for which the exact operating procedure was specified; this trajectory was followed by several off-nominal trajectories for which no operating procedure was specified. The results of the investigation showed that if velocity and altitude information were available, the pilots could consistently establish orbits lying within an altitude range from 361 000 to 611 000 ft by using rather crude thrust angle measurements. The characteristic velocity required to perform the maneuver was within 5% of that required for a perfectly flown nominal. Author

N65-16720 Joint Publications Research Service, Washington, D. C.

MATHEMATICAL PROBLEMS OF LAUNCHING ROCKETS

Yao-Ch'iu Lai *In its* Transl. on Communist China's Sci. and Technol., No. 145 9 Feb. 1965 p 1–7 (See N65-16719 07-34) OTS: $3.00

Data on two designated quadrangular areas of the Pacific Ocean in which a Russian rocket was predicted to impact in late 1962, are used to calculate the launching point location, the rocket trajectory range, the launching direction, and the allowed error in the launching azimuth. It is stated that the results are only approximate because allowance was not made for terrestrial ellipticity, terrestrial magnetism, air and wind resistance, or the gravitational attraction of celestial bodies. D.E.W.

N65-16761* Israel Program for Scientific Translations, Ltd., Jerusalem.

FUNDAMENTAL CONSTANTS OF ASTRONOMY

K. A. Kulikov 1964 221 p refs Transl. into ENGLISH of the book "Fundamental'nye Postoyanne Astronomi" Moscow, Gosudarst. Izd. Tekhn.-Teor. Lit., 1956 Published for NASA and NSF *Its* Cat. no. 1016

(NASA-TTF-143; OTS-64-11022) OTS: $2.25

The fundamental constants of astronomy and the methods for their determination are described. Included are the determinations of the velocity of light, and the Clairant–Radó and Darwin constants. The precession nutation formulas are briefly derived. R.L.K.

N65-16776# Arizona Univ., Phoenix. Lunar and Planetary Lab.

LABORATORY RESEARCH ON GASES OCCURRING IN PLANETARY ATMOSPHERES Final Report, Jun. 1, 1963–May 31, 1964

Gerard P. Kuiper [1964] 10 p refs

(Grant Nonr(G)-00014-64)

(AD-608352)

The major effort of the research was concerned with the atmospheres of Mars and Jupiter. A photographic spectrogram was calibrated using the 72-foot multiple-path absorption tube, and the abundance of CO_2 in the Martian atmosphere was derived. The result was 46 $\pm$20 meter atm for an assumed Martian atmospheric temperature of 200° K. Studies on the determination of atmospheric pressure and of abundances of other gases are also reported. The analysis of the photographic spectrum of Jupiter was extended to longer and to shorter wavelengths. All of the planetary absorptions observed in the long wavelength region were due to either methane or ammonia. Upper limits were set on the abundances of a number of gases: acetylene, ethylene, ethane, methylamine, methyl deuteride, hydrocyanic acid, silane, and hydrogen deuteride. Low dispersion spectra of Saturn, Uranus, and Jupiter satellites Io and Ganymede were also studied. D.S.G.

N65-16789# Michigan Univ., Ann Arbor.

BASIC SOLAR RESEARCH Annual Report, Oct. 1, 1963–Oct. 1, 1964

O. C. Mohler [1964] 10 p refs
(Contract Nonr-1224(19); Proj. VELA)
(AD-608730)

Studies summarized include (1) an initial survey and organization of spectroheliographic records of solar activity, 1958–1961; (2) analysis of the wavelength-sweep records for July 16, 1959 and June 25, 1960; (3) The MacMath-Hulbert Observatory Working List of Flares and Daily Flare Index for 1963; (4) general relationships between flares, ionospheric, and geomagnetic disturbances, 1957–1961; (5) special studies of solar activity for the first 6 months of the IQSY; (6) an unexpected effect related to 29.5 days in cosmic ray data; (7) magnetic fields of large sunspots; (8) magnetic classification of sunspots in the Mt. Wilson system, 1963–1964; (9) studies in the application of hydromagnetic theory to the sun; (10) continuation of the analysis of the observations of the decrease in intensity at the solar limb made during the July 20, 1963 eclipse; (11) investigation of the profiles of weak iron lines; (12) wavelength measurement for various groups of lines in the solar spectrum; and (13) studies of the relative abundances of the chemical elements in the solar atmosphere. R.L.K.

N65-16809*# Philco Corp., Palo Alto, Calif. WDL Div.
USER'S MANUAL FOR INTERPLANETARY ERROR PROPAGATION PROGRAM
15 Nov. 1963 73 p refs
(Contract NAS5-3342)
(NASA-CR-60693; WDL-TR2185) OTS: HC $3.00/MF $0.75

A description is presented of the manner in which an error propagation data run is set up. A detailed description of the input data and the format to be used for the data are shown. The results obtained for an example test case using a nominal lunar trajectory are included. Author

N65-16834*# Republic Aviation Corp., Farmingdale, N. Y.
THE HAMILTON-JACOBI FORMULATION OF THE RESTRICTED THREE BODY PROBLEM IN TERMS OF THE TWO FIXED CENTER PROBLEM
Mary Payne et al 19 Jun. 1962 40 p refs
(Contract NAS8-2605)
(NASA-CR-51736; RAC-720-2; ARD-898-451) OTS: HC $2.00/MF $0.50

In pursuing research regarding guidance and spaceflight theory relative to the rendezvous problem, an outline of the development of a perturbation procedure for solving the restricted three-body problem, using the solution of the two-fixed-center problem as an intermediate orbit, is presented. The solution for the two-fixed-center problem is combined with a Hamiltonian development of the problem to show how perturbation equations for the restricted problem may be obtained. In the restricted problem, it is assumed that the two primary bodies move in circles about their center of mass, the barycenter, and that the primary bodies are fixed in a coordinate system rotating with their angular velocity. P.V.E.

N65-16920*# National Aeronautics and Space Administration, Washington, D. C.
NASA SPACE SCIENCE AND APPLICATION PROGRAM
News Release
Homer E. Newell 2 Mar. 1965 22 p Presented at the NASA-Univ. Program Rev. Conf. Luncheon Meeting, Kansas City, Mo., 2 Mar. 1965 Available from the Scientific and Technical Information Div.

Mr. Homer E. Newell gives a general review of NASA's space science and applications program. Space science is defined as an extension of basic science made possible by the availability of rockets, satellites, and deep space probes; and its impact on geophysics, astronomy, physics, and the biosciences is discussed. The space science program has been designed to enable universities and colleges to solve scientific problems, in the manner of proven scientific tradition, to uphold the integrity of science and scientists. G.G.

N65-16923*# National Aeronautics and Space Administration, Washington, D. C.
SPACE AND PLANETARY ENVIRONMENT
Jul. 1963 33 p refs Presented at Manned Planetary Mission Technol. Conf., Lewis Res. Center, Cleveland, 21–23 May 1963
(NASA-TM-X-50116) OTS: HC $2.00/MF $0.50

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1. PARTICLE AND FIELDS IN INTERPLANETARY SPACE H. R. Anderson (JPL) p 1–15 (See N65-16924 07-30)
2. METEOROID HAZARDS IN NEAR EARTH AND DEEP SPACE C. T. D'Aiutolo p 19–31 refs (See N65-16925 07-30)

N65-16924* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARTICLE AND FIELDS IN INTERPLANETARY SPACE
Hugh R. Anderson *In* NASA, Washington Space and Planetary Environment Jul. 1963 p 1–15 (See N65-16923 07-30) OTS: HC $2.00/MF $0.50

The propagation of penetrating charged particles and gamma rays in interplanetary space is considered in relation to manned space flight because of their penetration of thick shields. The large solar cosmic ray events are the only radiation there, which is known to be hazardous to man. In the years 1956 to 1961, active regions which produced such outbursts appeared on the average of once every 18 months. There is a tendency for large events to occur more frequently when solar activity is increasing or declining than at the maximum or minimum of activity. Radiation reaches the earth no later than 3 hours after the flare, and is usually delayed less than an hour. However, up to an hour's exposure to the most intense fluxes observed would not be fatal. Large outbursts are generated in well-developed active regions on the sun. It has been suggested that hazardous and safe intervals of a few days can be predicted 1 or 2 weeks in advance by observing the size of sunspot penumbra in active regions. No method is known to predict large flares many weeks or months in advance. R.L.K.

N65-16925* National Aeronautics and Space Administration, Washington, D. C.
METEOROID HAZARDS IN NEAR EARTH AND DEEP SPACE
C. T. D'Aiutolo *In its* Space and Planetary Environment Jul. 1963 p 19–31 refs (See N65-16923 07-30) OTS: HC $2.00/MF $0.50

Although the meteoroid hazard has not been adequately evaluated for proper design of spacecraft for near-earth, cislunar, or interplanetary space missions, the extent of meteoritic encounters on space exploration may be estimated. The available information about meteoroids and cosmic dust obtained from ground-based observations and satellite measurements, with particular emphasis on the results of the Explorer XVI, is used to estimate the distribution of meteoroids near the earth and in interplanetary space. An estimate of the hazard was made using appropriate hypervelocity cratering criteria.

It is shown that, based on current results, the penetration hazard due to sporadic meteoroids in interplanetary space is expected to differ little from that near earth. However, for long missions, near the earth, it will be necessary to design optical surfaces and thermal coatings with due regard to the dust belt encompassing the earth. The effects of meteoroid showers and asteroids are briefly discussed, and it is concluded that more research is required before spacecraft can be properly designed to fulfill their missions in near-earth as well as interplanetary space environments. Author

N65-16939# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SOIL BEHAVIOR IN A LOW AND ULTRAHIGH VACUUM
J. D. Halajian 47 p refs Presented at the Ann. Meeting of the Am. Soc. of Mech. Engr., Lunar Base Session, New York, Dec. 1964
(RE-197J)

The behavior of simulated lunar soils is investigated by utilizing recent advances in vacuum technology and known principles of soil mechanics and surface chemistry. The effect of the gaseous and adsorbed phases on the behavior of the solid particles is evaluated in separate experiments. It is found that the absence of either phase has a hardening effect on soils. This is demonstrated by (1) increased bearing strength of "fluff" at 10^{-3} torr, and (2) extensive sticking of tumbling dust particles at 10^{-10} torr. The latter phenomenon is attributed to the depletion of adsorbed films. The experimental evidence favors a clean-surface rather than an electrostatic mechanism of adhesion but is not conclusive. Improved experimental techniques are suggested to overcome a number of difficulties that have hampered the quantitative measurement of soil adhesion and friction in vacuo. Beneficial and adverse effects of the above phenomena on various aspects of lunar surface operations are implied. Author

N65-17000*# IIT Research Inst., Chicago, Ill.
NONLINEAR ANALYSIS OF PHYSICAL LIBRATIONS. PART I: NEW FORMULATION AND EQUILIBRIUM ORIENTATIONS DEDUCED FROM AN INTEGRAL OF MOTION
R. L. Duncombe (Naval Obs.) and I. Michelson Washington, NASA, Feb. 1965 23 p refs Presented at the 15th Intern. Astron. Congr., Warsaw, 11 Sep. 1964
(Grant NsG-561)
(NASA-CR-168) OTS: HC $1.00/MF $0.50

Satellite orientation in space is affected by the unequal attractions of its parts toward the distant centroid of its primary, which is the earth—both for artificial satellites and for the moon. In passive systems of satellite attitude control, the resultant torque attributable to the gradient of gravity forces within the satellite is of dominant importance. Both Lagrange and Laplace gave the theoretical basis for discussion of satellite rotations in their analyses of lunar librations. Hamiltonian methods and modern computer techniques permit more accurate calculations for satellites of arbitrary configuration in generalized orbits. With respect to lunar librations also, new insights are provided on persistent difficulties in the classical treatment. Author

N65-17075*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TRAJECTORIES LAUNCHED NORMAL TO THE ECLIPTIC
John V. Breakwell Mar. 1963 24 p ref Presented to the 14th Intern. Astron. Federation, Paris, 26 Sep.–1 Oct. 1963
(Contract NAS8-2469)
(NASA-CR-52610) OTS: HC $1.00/MF $0.50

A one-dimensional approximate description is given for the motion relative to earth of a vehicle launched normal to the ecliptic without excessive escape speed. A linearized perturbation treatment is provided for deviations from this one-dimensional motion, that are the result of the combined effects of the initial trajectory and the perturbations of moon and sun (the moon's orbit is regarded as circular in the ecliptic plane). The eccentricity of the earth's orbit is also disregarded, and, on this basis, certain periodic motions which pass conveniently close to earth are found for this "restricted 4-body problem." Author

N65-17114*# National Aeronautics and Space Administration, Washington, D. C.
ON THE HILDEN-MOULTON HYPOTHESIS OF THE ORIGIN OF GEGENSCHEIN. COMMUNICATION 6: ON THE PRESENT STATUS OF THE QUESTION OF EXISTENCE OF THE HILDEN-MOULTON CLUSTER [O GIPOTEZE GIL' DENA-MULTONA O PROISKHOZHDENII PROTIVOSIYANIYA]
N. Moiseyev Feb. 1965 10 p Transl. into ENGLISH from Astron. Zh. (USSR), v. 15, no. 3, 1938 p 226–231
(NASA-TT-F-293) OTS: HC $1.00/MF $0.50

The preliminary results of the first round of investigations, reported in five notes by Reyn, Duboshin, Tarasashvili, and Moiseyev, are reviewed. It is concluded that the preliminary results are not favorable for the Hilden–Moulton hypothesis, and the studies to be included in the Sector's second series of investigations are listed. Author

N65-17117*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY INVESTIGATION OF THE HANDLING QUALITIES OF A VEHICLE IN A SIMULATED LUNAR GRAVITATIONAL FIELD
Peter C. Boisseau, Robert O. Schade, Robert A. Champine, and Henry C. Elkins Washington, NASA, Feb. 1965 27 p refs
(NASA-TN-D-2636) OTS: HC $1.00/MF $0.50

A flight-test investigation was conducted in connection with the development of a lunar landing simulator to provide information concerning the handling qualities of a tethered manned lunar-landing vehicle operating in a simulated lunar gravitational field. Proportional-type controls were used; no artificial stabilization was used. The results of the investigation are based entirely on pilots' opinions. The piloting task was visual hovering. The arrangement of the pilot's controls was good and the control sensitivity was harmonious. Under these conditions the vehicle could be maneuvered fairly easily with reaction-jet controls, and the control power required in pitch, roll, and yaw was found to be somewhat higher than that required by helicopters. Larger pitch and bank angles were required for linear acceleration. Height control of the vehicle with a vertical-acceleration capability of only 0.06g and no vertical-velocity damping was considered to be unsatisfactory for normal operation. Author

N65-17118*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TECHNIQUE FOR DETERMINING PLANETARY ATMOSPHERE STRUCTURE FROM MEASURED ACCELERATIONS OF AN ENTRY VEHICLE
Victor L. Peterson Washington, NASA, Feb. 1965 22 p refs
(NASA-TN-D-2669) OTS: HC $1.00/MF $0.50

A detailed procedure was developed for obtaining the density and pressure structure of a planetary atmosphere from measurements of accelerations experienced by a vehicle

making an uncontrolled entry into the atmosphere. It was shown that simplification in the method is possible and a potentially large source of error is eliminated if the accelerometers are carried by a spherically shaped vehicle. Sample calculations were made to illustrate how well extreme model atmospheres for Mars could be defined by this technique. Results of the calculations showed that accelerometers designed to measure over the entire range of expected accelerations with an accuracy of 0.1% would not provide sufficiently precise data. If, however, the time period over which large errors in measured accelerations are encountered is reduced or the acceleration measurements are improved by resorting to a dual system in which one set of instruments measures over the entire range of expected accelerations and the other over a more limited range, then any of the model atmospheres within the extremes can be determined reasonably well. Author

N65-17119*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LINEAR ACCELERATION GUIDANCE SCHEME FOR LANDING AND LAUNCH TRAJECTORIES IN A VACUUM
Victor R. Bond Washington, NASA, Feb. 1965 20 p refs
(NASA-TN-D-2684) OTS: HC $1.00/MF $0.50

Guidance equations are developed for guiding a spacecraft with finite continuous thrust from an initial position and velocity to a terminal position and velocity in a vacuum. The solution to this two-point boundary-value problem is obtained by assuming that the change in altitude and out-of-plane distance during the motion is small compared with the initial radius from the center of the attracting body to the spacecraft, and by prescribing linear acceleration for each of the three acceleration components. The resulting thrust, in general, is variable, but by introduction of a constraining relation, constant-thrust trajectories can be generated. Similarly, by introduction of another constraining relation, constant-pitch-angle trajectories may be generated. The guidance equations obtained may be used to guide a spacecraft to a landing on the moon, or to guide a spacecraft during launching from the moon. A comparison of these results with an optimum trajectory shows that the guidance equations yield a near-optimum trajectory for the case of a range-free, constant-thrust landing maneuver to a point near the lunar surface. Author

N65-17122*# Marquardt Corp., Van Nuys, Calif. Power Systems Div.
STUDY OF THE RETRIEVAL OF AN ASTRONAUT FROM AN EXTRA-VEHICULAR ASSIGNMENT
Warren H. Straly and Robert W. Adlhoch Washington, NASA, Feb. 1965 215 p refs
(Contract NAS1-2577)
(NASA-CR-185) OTS: HC $6.00/MF $1.25

This study considers the retrieval of a tethered astronaut from an extravehicular assignment. An investigation of the properties of two tethered objects in an orbit and an analysis of the problems associated with effecting a union of the two are considered. It was found that successful retrieval can be made only over a narrow range of conditions when angular momentum is conserved. Angular momentum dissipation techniques, however, extend the operational envelope so that retrieval can be accomplished over a wide range of conditions. The philosophies and techniques developed may be utilized in other orbital applications, such as space vehicle rendezvous and docking, satellite inspection, trajectory alteration, remote handling, etc. Author

N65-17261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP-C: ORBIT AND LAUNCH TIME ANALYSIS
Stephen J. Paddack and Barbara E. Shute Jan. 1965 66 p refs
(NASA-TM-X-55128; X-643-65-40) OTS: HC $3.00/MF $0.75

The highly eccentric IMP–C orbit is analyzed to find the times available for successful launch. The four mission restraints are (1) lifetime, at least 1 year (mandatory); (2) spin axis–sun angle between specified limits (mandatory); (3) time in shadow not to exceed certain limits (desired), and (4) apogee-sun angle below a specified value and decreasing (desired). The resulting time available for launch which satisfies these conditions is shown on a launch window map, and also in tabular form. The analysis takes into account the anticipated dispersion on injection speed, and also the high frequency perturbative effects of the moon. An analog computer program was used. R.L.K.

N65-17288*# Rensselaer Polytechnic Inst., Troy, N. Y.
GUIDANCE AND COMPUTER SCHEME FOR MANNED LUNAR LANDING
C. N. Shen [1964] 7 p ref Presented at the 15th Intern. Astronautical Congr.
(Grant NsG-14-59)
(NASA-CR-56215) OTS: HC $1.00/MF $0.50

A continuous thrust is employed for braking a vehicle from orbit to landing. The nonlinear guidance and computer scheme can be carried by the space vehicle to eliminate the inherent delay of an earthbound radio command system from the moon. Altitude and angular momentum for the computer scheme can be carried by the space vehicle to eliminate the scheme can be measured on board by radar and gyroscopic equipment operated by an astronaut. A bull's-eye landing is guaranteed by using the proposed system without tracking stations on the moon. Author

N65-17291*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VENUS-MARS CAPSULE STUDY, VOLUME II
1 Mar. 1963 741 p refs Revised Prepared for JPL
(Contracts NAS7-100; JPL-950250)
(NASA-CR-50811; AD-441924) OTS: HC $10.41/MF $3.50

The equilibrium composition and thermodynamic properties of the Venusian atmosphere have been calculated based on two proposed model compositions. The two model compositions were assumed to contain nine and twenty-five percent CO_2, respectively. The calculations cover the temperature range 200° + 15 000° K and the $\log_{10} \rho/\rho_0$ range of −7.0 to 1.8 at 200° K and 0.4 intervals. An ideal gas mixture in chemical equilibrium is assumed, including the dissociation and ionization calculations. At the higher temperatures, $T > 3000°$ K, thirty gaseous species have been included in the mixture calculations. P.V.E.

N65-17364# RAND Corp., Santa Monica, Calif.
RELATIVISTIC GALACTIC MORPHOLOGY I: GENERAL THEORY
Dominic G. B. Edelen Dec. 1964 99 p refs
(RM-4017-RC; AD-608824)

Although the morphological theory presented in this paper does not depend on discretization for its validity, it constitutes a natural extension and refinement of previous results in which it was concluded that discretization effects may be manifest in galactic structures; therefore, the underlying concepts leading

to that conclusion are summarized. The prediction of discretization comes from the eigenvalues of the partial differential equation that determines the function ψ, a single-valued bounded solution of the inhomogeneous Klein–Gordon equation, and from the conjecture that the jump in energy density is the same for all galaxies in a given subclass. This paper is devoted to the mathematical and physical properties of the eigenfunctions themselves. The physical predictions resulting from the eigenfunctions relate to the geometric morphology of galaxies, and hence are more closely associated with observed properties. D.S.G.

N65-17378# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

PHOTOGRAPHIC POLARIMETRY OF THE MOON WITH LIGHT FILTER

N. P. Barabashov and I. K. Koval Dec. 1964 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Komis po Fiz. Planyet (USSR), no. 1, 1959 p 55–58
(RSIC-349; AD-610051)

An analysis of moon photography showed the following: (1) The majority of lunar details studied have maximum degrees of polarization in blue rays. (2) Certain lunar details have a maximum degree of polarization in red rays. (3) Considering only red and blue light filters, the degree of polarization on a large lunar region has a maximum in blue along Tycho's ray. (4) A lunar polarimetric method with filters can produce interesting results, especially if compared with similar measurements of terrestrial substances. (5) The experiment of photographic polarimetry of the moon with light filters has shown that identical measurements with the help of electropolarimetry will be more precise and less laborious. E.E.B.

N65-17462*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SOME EFFICIENT COMPUTATION TECHNIQUES INCLUDING THEIR APPLICATION TO TIME OPTIMAL TRAJECTORIES FROM PARKING ORBIT

William B. Tucker Washington, NASA, Mar. 1965 59 p refs (NASA-TN-D-2691) OTS: HC $3.00/MF $0.50

Some efficient techniques are developed for generating time optimal trajectories from parking orbit to desired terminal conditions. Each technique is illustrated with a specific detailed application to the lunar-interplanetary trajectory problem (assuming one powered phase from parking orbit to injection into the transit conic). The techniques developed are in the following general areas of interest: formulation of the differential equations for the control variables; parametric representation of the control variables, transformations relating the various parameters, and the efficient use of these parameters; transversality conditions, with emphasis on their application to the lunar-interplanetary cutoff surface constraints; transformation of mission objectives into target arrival conditions that are efficient for use in multivariable isolation schemes. Fundamental, motivating discussions are included to aid in adapting the techniques or principles to the solution of other problems. Author

N65-17489# Joint Publications Research Service, Washington, D. C.

LIGHT REFLECTION FROM THE LUNAR SURFACE

L. A. Akimov 25 Feb. 1965 8 p Transl. into ENGLISH from Tsirkulyar Astron. Obs. (Kharkov), no. 26, 1963 p 43–46 (JPRS-28888; TT-65-30387) OTS: $1.00

In the investigation of the photometric characteristics of the lunar surface, it was found that the law of light reflection from the lunar surface can be represented in the form $B = A_0 f(\alpha)\phi(\lambda,\alpha)$, where B is the brightness of a point on the moon, A_0 is the brightness of this same point at time of full moon, $f(\alpha)$ is the invariant phase function dependent only on the phase angle α, $\phi(\lambda,\alpha)$ is the brightness distribution on the disk for a given phase, and λ is the longitude of a point on the moon. Calculations of the brightness distribution over the disk are made, and results are presented in tabular form as well as by graphs. The results indicate a satisfactory agreement with observations; deviations are observed only at the limbs of the disk and for certain special formations. D.S.G.

N65-17490# Joint Publications Research Service, Washington, D. C.

STRUCTURE OF THE LUNAR SURFACE

N. P. Barabashov 25 Feb. 1965 9 p refs Transl. into ENGLISH from Tsirkulyar Astron. Obs. (Kharkov) no. 26, 1963 p 14–19
(JPRS-28889; TT-65-30388) OTS: $1.00

Measurements of lunar brightness and of light reflected from various laboratory samples are compared in tables. It is concluded that the lunar surface cannot be covered by very fine unconsolidated material or dust, that the law of reflection from the lunar surface differs considerably from the law for the volcanic ash investigated, and that the lunar surface also does not resemble volcanic slag. It is asserted that the surface is covered either by an extraordinarily spongy layer with very thin but opaque walls separating the individual pores, or by pointed and closely spaced opaque fragments consisting of greatly fractured tuff-like volcanic rocks that do not have mirror properties. D.E.W.

N65-17491*# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM *VESTNIK ACADEMII NAUK SSSR*, NO. 10, 1964: COLLABORATION BETWEEN THE USSR AND THE UNITED STATES IN SPACE RESEARCH

A. A. Blagonravov 25 Feb. 1965 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 10, 1964 p 82–84
(JPRS-28890; TT-65-30389) OTS: $3.00

The results of discussions between scientists representing the Soviet Union and the United States at Geneva since 1962 are presented in broad outline. The rapid exchange of meteorological data, the future of communications satellites, magnetic surveys of the earth during the IQSY, successful facsimile transmissions via ECHO 2, the establishment of a duplex 24-hour channel between Moscow and Washington, and specific magnetometer data for exchange are discussed. A Soviet proposal about collaboration in space biology and medicine is reported, international negotiations of the United States with regard to ComSat are discussed with disfavor, and strong optimism is expressed about sharing scientific information in the future. D.E.W.

N65-17500# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.

THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE: OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC EMISSION AT 408 Mc/s Progress Report, Apr.–Jun. 1964

Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1964] 8 p refs
(Contract N62558-3928)
(PR-3; AD-608547)

The occultation of 3C 17 April 11, 1964 was observed with the 178 Mc/s total power receiver, and the times of disappearance and reappearance behind the moon were U.T. $11^h48^m24^s$ and U.T. $12^h57^m47^s$ respectively. This difference of less than 4 seconds from formerly deducted occultation positions was attributed to signal interference. The immersion of 3C 17 on June 5, 1964 occurred at U.T. $07^h26^m06^s$ on 240 Mc/s receiver. Comparison of occultation times of MSH 12+02 on May 20, 1964 on 408 Mc/s with earlier observations of the same type yielded the following position (Epoch 1950): right ascension $12^h03^m46^s$ and declination +04° 22'28". Measurements of the changes in aerial temperature during observations, and comparison to the known values of the main beam solid angle showed that only 20% of the power is distributed away from the main beam aerial. Reevaluation of the area $1^{II} = 30°$, $b^{II} = 10° - 40°$ of the spectrum of the Spur indicate that the Spur spectrum is less steep than that of the background. Successful observation of the immersion and emersion of the source 12+02 at 408 Mc/s were made on May 20–21 and showed a source flux density of about 8 units. G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-16346*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEW KNOWLEDGE OF THE EARTH'S ATMOSPHERE FROM THE AERONOMY SATELLITE (EXPLORER XVII)
N. W. Spencer, G. P. Newton, C. A. Reber, L. H. Brace, and R. Horowitz May 1964 33 p refs Presented at the Space Sci. Symp., Florence, May 1964
(NASA-TM-X-54989) OTS: HC $2.00/MF $0.50

The Explorer XVII satellite performed direct, very localized measurements of the total neutral particle density, the concentration of neutral particle masses 4, 14, 16, 28, and 32, and the temperature and concentration of thermal electrons between the altitudes of 258 and 920 km, over those regions where the satellite was accessible to the Minitrack network, and in particular between ±58° latitude. Pressure gages on the satellite showed that the total density at 280 km was about 50% lower than is given by the appropriate atmospheric models based on satellite drag measurements. Daily variations in total density are more strongly dependent on a_p (the magnetic index) than had been believed previously. Neutral mass spectrometers showed that H_e is the predominant neutral constituent above 600 km, O is predominant between 250 and 600 km, and N_2 is predominant below 250 km. The scale heights of the various constituents agree in general with the corresponding model atmospheric scale heights. Langmuir probe results confirmed the global extent of thermal nonequilibrium ($T_e > Tg$), and provided high resolution of the diurnal variation of electron temperature and density at several stations. Author

N65-16350*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NO. 23
15 Dec. 1964 16 p
(NASA-TM-X-54993) OTS: HC $1.00/MF $0.50

Satellite orbital data computed and compiled by the Goddard Space Flight Center, by NORAD, and by the Smithsonian Astrophysical Observatory are presented. The data are arranged in tables of objects in orbit, and of objects that decayed during November 1964. The tables give the code names, the designations, and catalog numbers of the objects, their source countries, launch dates, nodal periods, inclinations, apogees, perigees, and transmitting frequencies. R.L.K.

N65-16437*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
MARINER B/VOYAGER ENTRY CAPSULE PRELIMINARY DESIGN STUDY Final Report
M. G. Boobar 10 Oct. 1963 289 p refs Prepared for JPL (Contract JPL-BE-4-21764)
(NASA-CR-53675; SID-63-1293) OTS: HC $6.00/MF $1.50

Parametric studies on environment, trajectory, heating, materials considerations and constraints, design and geometric constraints, structural, heat shield, and landing system tradeoffs, and dynamic considerations, are included. Also presented is design information on selection, heat shield-structural requirements, landing systems, and capsules. E.E.B.

N65-16564# Applied Physics Lab., Johns Hopkins Univ. Silver Spring, Md.
SPACE PROGRAM Quarterly Report, Jul.–Sep. 1964
[1964] 17 p refs
(Contract NOw-62-0604-c)
(U-SQR-64-3; AD-456563)

Environmental testing of the polar ionosphere beacon satellite S-66, S/N 35, has proceeded through the thermal vacuum and flight acceptance vibration testing stage. To aid in the selection of an optimum boom configuration, an analysis of solar differential heating is in progress that has led to the decision to consider only a high-emittance internal surface for the balance of the study. To establish the feasibility of using extremely long booms as low-frequency antennas, studies were conducted on the effects of solar and gravitational influences on various configurations. Among several units under design for the Direct Measurement Explorer satellite is a TM transmitter of a new modular concept. For the GEOS satellite, memory circuits were designed, breadboarded, and tested for the entire environmental temperature range. Other work on GEOS included design completion of several instrumentation units. A magnetic ball-in-ball damper, designed for gravity-gradient oriented satellites such as LIDOS, was proven feasible. In the ANNA (LIDOS) Program, a dual-frequency fan beam antenna was developed that provides desirable characteristics intermediate to simple-fixed-type and complex-steerable antennas. D.S.G.

N65-16639*# National Aeronautics and Space Administration. Washington, D. C.
SATURN I TO LAUNCH PEGASUS METEOROID DETECTION SATELLITE News Release No. 65-38
15 Feb. 1965 28 p
Available from the Scientific and Technical Information Division

The impending launch from Cape Kennedy of the first Pegasus meteoroid detection satellite using a Saturn I is announced by NASA. Pegasus, the largest unmanned instrumented satellite developed by NASA, will be launched on the eighth Saturn I flight. The Pegasus satellite will "sweep" space, detecting and reporting collisions with meteoroids. This information will give a better indication of the distribution, size, and velocity of such particles near the earth. The Pegasus satellite weighs about 3200 pounds, and it will be visible from the earth without the

aid of a telescope on clear nights. Pegasus will orbit the earth every 97 minutes, ranging in altitude from about 310 to 465 statute miles and inclined 31.7° to the equator. The desired lifetime of the solar-powered satellite is 1 year, although it may orbit 3 or more years. Background information is included on the booster, the satellite, the trajectory, the flight sequence, and tracking and data acquisition. R.L.K.

N65-16656# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH ALTITUDE ROCKETS
Vladimir Nemec and Stanislav Zapletal 26 Mar. 1963 12 p Transl. into ENGLISH from Kridla Vlasti (Czech.), no. 5, 1962 p 138–139
(FTD-TT-63-78/1+2; AD-402430)

State-of-the-art for high altitude rockets is discussed in general terms. Description, characteristics, tasks, structural problems, equipment, flight profile, and safety are treated. E.E.B.

N65-16748*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENTATION REPORT ON NIKE APACHE FLIGHTS 14.194 CA AND 14.195 CA
R. W. Conrad and J. R. Lease Feb. 1965 23 p
(NASA-TM-X-55125; X-671-64-301) OTS: HC $2.00/MF $0.50

All pertinent engineering data on actual flight instrumentation and the flight of two Nike-Apache payloads are described. The purpose of these flights was to gather scientific information on electron temperature and density, as well as wind profile. This study illustrates the function and performance of instrumentation and is not an analysis of either data or vehicle performance. Author

N65-16763# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
STATIC AERODYNAMIC STABILITY CHARACTERISTICS OF A TWO STAGE TANDEM WINGED RECOVERABLE LAUNCH VEHICLE (ASTRO) AT SUBSONIC AND SUPERSONIC MACH NUMBERS. VOLUME 1: MODEL BUILD UP
D. M. Pell May 1964 315 p refs
(SM-47628, Book I)

Model buildup data obtained from wind tunnel tests of an 0.83-percent scale model of the Astro Phase II vehicle are presented. The vehicle configuration was composed of two geometrically similar lifting-type vehicles, in tandem arrangement. Six-component force and moment data were obtained for the forward and aft stages of the vehicle and for the total vehicle. Author

N65-16828*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
MARS-VENUS CAPSULE PARAMETER STUDY. VOLUME III: VENUS RESULTS
16 Jan. 1964 360 p
(Contract JPL-950626)
(NASA-CR-53673; RAD-TR-64-1) OTS: HC $7.00/MF $1.75

Residual weight tradeoffs due to vehicle shape were determined for seven Venus capsule shapes. A complete summary of the case generation for Venus is given. Trajectory calculations were done using the modified four-degree-of-freedom solution. Reference heat pulses were plotted for each trajectory. Combination of angle-of-attack envelope, and heat pulses is shown, as is peak dynamic pressure, time of Mach 1 occurrence, and summary tables of the elemental structural and heat shield weights for each vehicle. Residual weight summaries are presented indicating the gross heat shield, external structure, internal structure, and crushup structural weights. Tradeoffs are found for each of the governing parameters. The results generally point to a high drag vehicle as the most thermally and structurally efficient shape. However, trajectory results indicated that the two high drag designs had poor angle-of-attack performance at low altitudes. Part of this problem is most likely associated with the center of gravity position, and moments of inertia for these designs. Decreased residual weight was associated with the shallow entry angle, $\gamma_e = -15°$, increased entry velocity, increased gross weight, and increase in radiative heating. R.L.K.

N65-16842*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
MARS-VENUS CAPSULE PARAMETER STUDY. VOLUME II: MARS RESULTS
16 Jan. 1964 233 p
(Contract JPL-950626)
(NASA-CR-53672; RAD-TR-64-1, Vol. 2) OTS: HC $6.00/MF $1.25

Four capsule shapes for a Mars spacecraft were studied, and summary data are presented. The M1 shape had the most favorable residual weights due to small surface area, and the relative high efficiency of the heat shield material in handling the radiative heating. The 20° entry angle resulted in the largest heat shield weight, the 90° entry angle in the largest structural weight. The reduction in entry velocity had a small effect on the residual weight due to angle of attack, nonequilibrium, and heat pulse shape differences. The only shape for which positive residual weights were found for an M/C_DA of 0.1 slug/ft^2 is the M1. The effect of the gross weight on the residual weight fraction tended to be small, but increasing the weight resulted in a smaller residual weight fraction. The spin rate was found to have an important effect on the angle-of-attack envelope, the peak loads, the heating, and the residual weights. The stability parameter was found to significantly change the angle-of-attack history at low altitude. Important problem areas included angle of attack, radiation heating, convective heating, and heat shield performance. R.L.K.

N65-16966*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT: PROJECTS MERCURY AND GEMINI
[1964] 1 p
(NASA Facts, Vol. II, No. 8) GPO: $0.20

Significant events in the Mercury project are reviewed. The Gemini project is outlined to include spacecraft description, guidance, communications, environmental control, launch vehicle, tracking, reentry, and recovery. Biomedical and bioastronautical experiments, and astronaut selection and training are also included. E.E.B.

N65-17217*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
SURVEYOR/CENTAUR AIR CONDITIONING TEST PLAN
H. C. Cloud and R. R. Weiss 1 Sep. 1963 46 p Prepared for JPL
(Contracts NAS7-100; JPL-950045)
(NASA-CR-60461) OTS: HC $2.00/MF $0.50

Technical data, equipment requirements, test procedures, test support requirements, and documentation for air-conditioning test plan for the temperature environment control are given for Surveyor/Centaur. A PERT analysis of the air conditioning test and the test schedule are provided. E.E.B.

N65-17222*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
LUNAR ORBITER CAPSULE STUDY Final Report
3 Aug. 1962 333 p refs Revised ed. Prepared for JPL
(Contracts NAS7-100; JPL-950340)
(NASA-CR-60748; AED-1542) OTS: HC $7.00/MF $1.75

This design analysis of a lunar orbiter, to accomplish the tracking and television experiments within the allowed payload for a Ranger spacecraft, considers the two major tasks of the television mission and the selenodetic mission, and the separate sets of restraints which they impose on the orbit. It was concluded that this design is feasible and that the required development time is dependent on the design of the attitude control subsystems, and the retropropulsion subsystems. G.G.

N65-17308# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN OF FLYING CRAFT (SELECTED CHAPTERS)
V. L. Bel'skiy, I. P. Vlasov, et al 30 Nov. 1964 389 p refs Transl. into ENGLISH from the book "Konstruktsiya Letatel'nykh Apparatov" Moscow, Gos. Nauchn.-Tekhn. Izd., 1963 p 85–113, 124–386, 445–464
(FTD-TT-64-1018/1+2; AD-608751)

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N65-17354# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF OPERATIONAL AND STRATEGIC ROCKETS IN THE UNITED STATES
I. Zheltkov 25 Mar. 1964 20 p refs Transl. into ENGLISH from Voyenno-Istoricheskiy Zh. (USSR), no. 2, 1963 p 37–47
(FTD-MT-63-239; AD-605903)

A survey of postwar development of long-range rocket weapons, and of American rocket technology led to these conclusions: (1) Technical-tactical characteristics of rocket weapons show continuing improvement. (2) The scope of solving firing problems was broadened. (3) Great effort is being applied to the development of second-generation ballistic rockets with solid fuel engines, reliable and accurate systems of control, mobile launching equipment, and interchangeable warheads. M.G.J.

N65-17409*# National Aeronautics and Space Administration, Washington, D. C.
NASA'S FIFTH CENTAUR FLIGHT TO TEST SURVEYOR DYNAMIC MODEL
1 Mar. 1965 18 p
(NASA News Release-65-65) Available from the Office of Scientific and Technical Information Division

NASA announces the launching of the Centaur vehicle after March 2, 1965. It will carry as payload a Surveyor dynamic model for further evaluation of the dynamic interaction between the Centaur and its payload during the powered phase of flight prior to injection. The flight plan was established to obtain data on an up-rated Atlas propulsion system and on the Centaur upper stage propellant utilization system. G.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-16374# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS Final Report, Oct. 1, 1963–Sep. 30, 1964
30 Sep. 1964 10 p refs
(Contract NObs-90041)
(Rept.-205.4; AD-608423)

Work completed on the stiffened plate panels project included the development of a computer program for analyzing the ultimate strength of longitudinally stiffened panels that have pinned or fixed end conditions and are subjected to combined axial and lateral loading. A literature survey on the post-buckling behavior of long plates has been initiated. A study has been made on the lateral-torsional-buckling problem for beam columns including the preparation of axial load vs end-moment interaction curves for unbraced beam columns. An evaluation of existing data led to the conclusion that the discontinuous nature of the yield process in steel is a significant factor influencing the postelastic lateral and local deformation behavior of wide-flange shapes. Work on multistory frames in three areas is discussed: (1) design methods for braced multistory frames, (2) planning for full-scale multistory frame tests; and (3) the analysis of unbraced multistory frames. R.E.S.

N65-16421# Naval Air Test Center, Patuxent River, Md. Flight Test Div.
INVESTIGATION OF VIBRATION IN ROTARY WING AIRCRAFT
Ronald N. Phillips 8 Apr. 1963 17 p refs
(TM-2-63; AD-412668)

Instruments are described for measuring vibration and systems used to record this information, methods for reducing data, and results of studies to determine the effect of vibration on components and man. Methods for attenuating some of the transmitted vibrations are suggested, and design specification requirements on helicopter vibration are proposed. Author

N65-16451*# National Aeronautics and Space Administration, Washington, D.C.
FREE OSCILLATIONS OF CIRCULAR CONICAL AND CYLINDRICAL SHELLS REINFORCED BY RIGID CIRCULAR RIBS

V. G. Godzevich and O. V. Ivanova Feb. 1965 11 p refs Transl. into ENGLISH from Aviatsionnaya Tekhnika (USSR), no. 1, 1964 p 54–59
(NASA-TT-F-291) OTS: HC $1.00/MF $0.50

The problem of free axially asymmetric oscillations of conical and cylindrical shells reinforced by a small number of circular ribs is discussed. A solution is obtained by satisfying the boundary conditions at the lines of contact between the ribs and the shell. Author

N65-16522# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE DETERMINATION OF SHAPE MODIFICATIONS FROM THE DIFFERENCES BETWEEN EXPERIMENTAL AND THEORETICAL RESULTS TO OBTAIN OPTIMUM CONFIGURATIONS
J. Stolz and Th. E. Labrujere 19 Dec. 1962 31 p refs
(NLR-TN-W.24)

This report presents a method to reshape an already designed optimum ring wing configuration for the perturbing influence of structural parts, such as stakes. This is effectuated by measuring the deviation of the velocity distribution on the so-called aft Mach cone from the theoretical one. This deviation is canceled by determining a new shape of the rear end of the fuselage, using a linearized theory and Riemann's method. It is shown that only very small perturbations can be canceled in this way. Author

N65-16555# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Labs.
LIGHT ALLOY ARMOR DEVELOPMENTS
Henry P. George Jan. 1964 30 p refs
(A64-27; AD-455964)

The strain-hardened aluminum armor alloys have made an impressive record in applications where resistance to fragments is the primary ballistic requirement. The planning of new vehicles such as the General Sheridan, XM551, with a reconnaissance and assault function, had indicated that it was essential to obtain additional resistance to armor-piercing projectiles without compromising seriously the weldability and other structural attributes. The aluminum industry has cooperated with the Army in developing improved aluminum alloys. Four leading candidate alloys were entered in a competitive evaluation known as Project HAAS. The winning material selected for fabrication of prototype vehicles was a heat-treated aluminum–zinc–magnesium, copper-free alloy. Stress corrosion aspects are also being explored. The effect of alloy purity on rolled aluminum armor, castable aluminum armor, and magnesium–lithium armor is also discussed. Author

N65-16579*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE UNDER RANDOM AND PROGRAMED LOADS
Eugene C. Naumann Washington, NASA, Feb. 1965 27 p refs
(NASA-TN-D-2629) OTS: HC $1.00/MF $0.50

An investigation was conducted to determine which combination of methods of counting and type of load programing best retains the essential fatigue-inducing characteristics of a random-time history of stress. The data obtained in an earlier investigation were used to conduct axial-load fatigue tests of 2024-T3 aluminum-alloy sheet specimens with notched edges. The fatigue life obtained from tests using the random peak history was used as a basis of comparison. The elimination of various sized fluctuations, due to the different counting methods, had little, if any, effect on fatigue life in tests using a random sequence of loads. Tests conducted by using ordered loading produced lives greater than the random fatigue life. The value of life in the ordered tests varied with the counting method, with statistical properties of the time history, and probably with the assumptions made in reducing the data to block form. Author

N65-16583*# Drexel Inst. of Tech., Philadelphia, Pa.
PROPAGATION OF CYLINDRICAL AND SPHERICAL ELASTIC WAVES BY METHOD OF CHARACTERISTICS
Pei Chi Chou and Herbert Abraham Koenig Washington, NASA, Feb. 1965 68 p refs
(Grant NsG-270-63)
(NASA-TN-D-2644) OTS: HC $3.00/MF $0.75

A set of generalized equations is presented which governs the propagation of plane, cylindrical and spherical dilatation waves in elastic media. The corresponding characteristic equations are then derived, including the propagation of abrupt changes (discontinuous wave fronts). Procedures of numerical integration along the characteristic directions are established and carried out for several examples on an electronic computer. The solutions of four of the specific examples calculated show excellent agreement with existing solutions by other methods. Certain interesting phenomena have been discussed which may have considerable significance in dynamic crack propagation and dynamic strength of materials. Author

N65-16587*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF THE ELASTIC-PLASTIC STRESS STATE AROUND A REINFORCED OPENING IN A SPERICAL SHELL
Albert Kaufman and David A. Spera Washington, NASA, Feb. 1965 26 p refs
(NASA-TN-D-2672) OTS: HC $1.00/MF $0.50

A study was made to correlate theoretical stresses and strains in a pressure vessel having a reinforced opening, with experimental data obtained for progressive stages of elastic-plastic deformation up to the point of failure. The pressure vessel consisted of a hemispherical dome 12 in. in diameter with a wall thickness of 0.060 in. and a reinforced opening 1 in. in diameter, and was machined from 6061 aluminum. The reinforcement was an integrally machined ring 1.70 in. in outer diameter and 0.300 in. thick. In general, there was good agreement between the experimental data and the theoretical results based on true stress–conventional strain data and modified shell dimensions. The conclusion was drawn that the theoretically computed elastic-plastic stresses can be used with the true ultimate tensile strength of the shell material to give a reasonably accurate prediction of the burst pressure. Also, the elastic stress-concentration factor can be used together with the true ultimate tensile strength to give a conservative approximation of this burst pressure. Author

N65-16597*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INFLUENCE OF EDGE CONDITIONS ON THE STABILITY OF AXIALLY COMPRESSED CYLINDRICAL SHELLS
B. O. Almroth Washington, NASA, Feb. 1965 39 p refs
(Contract NAS1-3778)
(NASA-CR-161) OTS: HC $2.00/MF $0.50

Recent investigations by Stein and by Fischer on the influence of edge conditions on the critical load of cylindrical

shells are extended to cover six additional combinations of boundary conditions. The results show that drastic reductions of the critical load for cylinders with lateral support of the edges are obtained only if the edges are free in the tangential direction. For other boundary conditions, this reduction is never more than about 20%. Consequently, the results of this investigation alone cannot explain the well-known discrepancy between theory and test data. However, the importance of the choice of boundary conditions for practical analysis is clearly demonstrated. Author

N65-16769# Laboratorium für Betriebsfestigkeit, Darmstadt (West Germany).
PROGRAM TESTS TO ESTABLISH SAFE DESIGN STRESSES FOR THE LOWER WING SURFACE OF A TRANSPORT AIRCRAFT
E. Gassner and G. Jacoby (DVL, Mülheim) [1964] 64 p refs Transl. into ENGLISH from Luftfahrttech.-Raumfahrttech. (West Germany), v. 9, no. 1, Jan. 1964 p 6–19
(LBF-50; ICAF-293)

An appropriate stress spectrum is established based on the significant loads and their frequency distribution. Various possibilities for its simulation in program tests are discussed and critically reviewed on the basis of available test results. To establish design stresses for structures made of an alloy (24 S–T 4 Al clad) with medium notch effects, fatigue tests with programed individual flights comprising all stress changes contained in the specified load spectrum seemed most suitable. A diagram based on such tests shows the connection between safe design stresses and prescribed fatigue life for the given stress spectrum. Accordingly, the safety factors required by airworthiness regulations for aircraft under the aspect of static strength must be increased locally by at least 85%, if, for instance, a safe fatigue life of 5000 flights is desired. A microfractographic examination facilitates additional statements on probable crack initiation and crack propagation rate. Author

N65-16882*# North American Aviation, Inc., Columbus, Ohio.
INVESTIGATION OF THE FATIGUE PERFORMANCE OF VISCO-ELASTIC PANELS AT ELEVATED TEMPERATURES
R. V. Bennett Washington, NASA, Feb. 1965 113 p
(Contract NAS1-3193)
(NASA-CR-162) OTS: HC $4.00/MF $0.75

The objectives of this program were to evaluate the fatigue characteristics of viscoelastic material and compare them with standard aluminum construction at temperatures up to 300° F and to determine joint characteristics of viscoelastic construction using standard rivets as fasteners at these temperatures. The test program included sonic fatigue, structural shear fatigue, axial-load static tensile, viscoelastic material static shear, and sonic fatigue panel vibration tests. The results of this program lead to the following main conclusions: (1) The sonic fatigue life of the viscoelastic material was generally longer than plain aluminum at all realistic temperature–sound pressure level conditions, with the superiority diminishing at 300° F and the higher sound pressure levels. (2) The structural shear fatigue life of round-head riveted viscoelastic shear panels was slightly less than plain aluminum shear panels from ambient temperatures to 300° F; the fatigue life of flush-head riveted viscoelastic panels was slightly less than aluminum panels at ambient temperatures and substantially less at 200° F and 300° F.
Author

N65-16889*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
STRUCTURAL AND MATERIALS INVESTIGATION OF A 1/8-SCALE-MODEL SPACE STRUCTURE OF TOROIDAL CONFIGURATION AND FILAMENTARY CONSTRUCTION
Jerry G. Williams and George P. Goodman Washington, NASA, Feb. 1965 42 p refs
(NASA-TN-D-2652) OTS: HC $2.00/MF $0.50

Structural design of the model is based on the isotensoid concept in which filamentary material is wound in the torus meridional plane and oriented to carry primary radial structural loads as constant tension in the filaments. Inner and outer equatorial bands provide strength in the circumferential direction. Tests were performed on the model to determine dimensional stability, filament load distribution, hypervelocity impact, and structural failure. Results indicated that the overall height of the meridian-plane cross section and the inner and outer diameters increased approximately linearly as the pressure was increased up to 56.0 psi. Strain-gage values of filament loading were approximately 18% less than theoretical values for the design operating pressure of 56.0 psi. Failure of the torus occurred at an internal pressure of approximately 94.0 psi, which is approximately 34% of the design load based on ultimate strength of the filaments. Structural failure was a result of separation of adjacent torus filaments and not of failure of the filaments themselves. Author

N65-16931# IIT Research Inst., Chicago, Ill.
PLASTIC INSTABILITY OF CYLINDRICAL SHELLS WITH RIGID END CLOSURES Topical Report, Jan. 1961–Jan. 1962
M. A. Salmon [1962] 106 p refs
(Contract AT(11-1)-528)
(IITRI-528-19) OTS: $2.25

Solutions are obtained for the large plastic deformations of a cylindrical membrane with rigid end closures subjected to an internal pressure loading. A plastic-linearly hardening material obeying Tresca's yield criterion and the associated flow rule is considered. It is found that, in general, a shell passes through three stages of deformation finally assuming a spherical shape. The instability pressure (maximum pressure) may be reached in any of the stages depending on the length/diameter ratio of the shell and the hardening modulus of the material. While numerical integration is required to obtain solutions for shells in the first two stages of deformation, the solution in the final stage is given in closed form. For the purpose of comparison exact solutions are also obtained in a few cases for a material obeying the Mises yield criterion. Author

N65-16964# ARO, Inc., Arnold Air Force Station, Tenn.
IMPACTS OF SPHERICAL PROJECTILES OF ALUMINUM, STAINLESS STEEL, TITANIUM, MAGNESIUM, AND LEAD INTO SEMI-INFINITE TARGETS OF ALUMINUM AND STAINLESS STEEL
J. J. Payne Arnold Eng. Develop. Center, Feb. 1965 35 p refs
(AEDC-TR-65-34; AD-456391)

Hypervelocity impact tests were performed using spherical projectiles of 1100-0 and 2024-0 aluminum, 304 stainless steel, commercially pure titanium, lead, and magnesium. The semi-infinite targets were of 1100-0, 1100-H14, and 2024-0 aluminum, and of 304 stainelss steel. Penetration data are presented for impact velocities from 4.1 to 7.9 km/sec, and are used to determine values of target deformation stress. The correlation between the penetration data and the empirical relation using these stress values is reasonable. Author

N65-17009# Naval Research Lab., Washington, D. C. Mechanics Div.

RESONANCE TESTING IN THE DETERMINATION OF FIXED BASE NATURAL FREQUENCIES OF SHIPBOARD EQUIPMENT

L. P. Petak and R. E. Kaplan 15 Dec. 1964 20 p refs
(NRL-6176; AD-610153)

Examination shows that the results of past shake tests to determine the fixed base natural frequencies of inplace shipboard equipment-foundation systems are not correct. A review of the equations of motion for a five-degree-of-freedom system revealed that choosing the driving point on the equipment could not give the desired frequencies. The review showed that the fixed base frequencies could be obtained if the driving point were on or below the base of the equipment-foundation system. Prominent valleys occur in the response of the supporting structure below the driving point. Comparison of these valleys with prominent peaks in a plot of the ratio of equipment response to base response will eliminate the extraneous frequencies of the structure below the driving point. Although this method functioned well when applied to systems simulated with an analog computer, it will be difficult in the field to place a shaker having sufficient force below the equipment. A situation involving rotation as well as translation magnifies the difficulties, since additional shakers are necessary which are capable of phase control and a range of force ratios at each frequency. Author

N65-17060*# California Univ., Berkeley.

FINITE ELEMENT SOLUTION FOR AXISYMMETRICAL SHELLS

Egor P. Popov, Joseph Penzien, and Zung-an Lu [1963] 35 p refs
(Grant NsG-274-63)
(NASA-CR-53093) OTS: HC $2.00/MF $0.50

A comprehensive method of analysis of axisymmetrical thin elastic shells of revolution based on finite element approach is presented. The basic finite element, by means of which any axisymmetric shell may be approximated, is a truncated conical ring. In the limiting case such an element is replaced by a short cylinder; at the ends of a shell, shallow spherical caps are employed. By using many elements, thickness variation of the shell can be approximated. The procedures are stated in matrix algebra and, in principle, are based on the displacement method of analysis. An example illustrates convergence of the proposed method. Author

N65-17085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NONSYMMETRICAL BUCKLING OF A FLAT ROUNDED SHELL WITH INITIAL DEFORMATION FROM EXTERNAL PRESSURE

Ivan Hlavacek 2 Dec. 1964 16 p refs Transl. into ENGLISH from Aplikace Mat. (USSR), v. 8, no. 6, 1963 p 399–410
(FTD-TT-64-354/1+2; AD-609780)

Algebraic equations are derived for computing the characteristics of load strain of the hinge-supported flat spherical shell, which has a nonsymmetrical initial buckling and is subjected to equally distributed external pressure. Author

N65-17121*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DETECTION OF FLOW-FIELD INSTABILITY IN THE PRESENCE OF BUFFETING BY THE PARTIAL-MODE MODEL TECHNIQUE

Henry A. Cole, Jr., Robert C. Robinson, and Bruno J. Gambucci Washington, NASA, Feb. 1965 35 p refs
(NASA-TN-D-2689) OTS: HC $2.00/MF $0.50

The partial-mode model technique for studying buffeting response of launch vehicles was extended to include motion with two node lines, as applied to Apollo/Saturn launch vehicles. The results obtained from free-oscillation records are studied through several stages of data refinement including rms, peak values of spectral density, and bandwidth of the spectral density. For the example shown, two unstable flow fields are indicated, one at a subsonic Mach number and another at a supersonic Mach number. Author

N65-17206# Ohio State Univ. Research Foundation, Columbus.

A STUDY OF THE POINT MATCHING METHOD AS APPLIED TO THERMALLY AND TRANSVERSELY LOADED PLATES AND OTHER BOUNDARY VALUE PROBLEMS Technical Report, Nov. 1962–Nov. 1963

F. W. Niedenfuhr, Arthur W. Leissa, and C. C. Lo Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 166 p refs
(Contract AF 33(657)-8772)
(AFFDL-TR-64-159; AD-610146)

Work was undertaken to develop further the point-matching technique for application to thermally and transversely loaded plates and associated boundary value problems; to develop computer programs, based upon the method, which are capable of universal usage to solve plate problems involving arbitrary shape and loading; to demonstrate the use of the computer programs on practical problems; and to investigate the mathematical convergence properties of the method. The equations of linear, thin, elastic plate theory, including thermal effects, are presented. Solutions to the governing differential equation require complementary and particular parts. Various forms of complementary and particular solutions suitable for handling arbitrary boundary shape and loading are presented, along with the resulting form of the slope, moment, and shear equations. Two forms of complementary solution are presented: the Michell solution, in polar coordinates, and the Levy solution, in rectangular coordinates. Three forms of particular solutuion are described: trigonometric and power series in rectangular coordinates, and concentrated load functions. The application of these solutions by the point matching method to the problems of thermally and transversely loaded plates are demonstrated by several examples. Application of the point matching method to other boundary value problems—torsion, conductive heat transfer, plane elasticity, slow motion of a viscous fluid, membrane deflection, and electromagnetics—solvable in terms of harmonic and biharmonic functions is described. A method of analyzing plates having both transverse and in-plate loads is presented. This method uses an iterative application of the point matching technique. Some limitations and considerations when using the point matching technique are described. Author

N65-17314# Northwestern Univ., Evanston, Ill. Technological Inst.

ON THE STABILITY OF ELASTIC SYSTEMS SUBJECTED TO NONCONSERVATIVE FORCES

G. Herrmann and R. W. Bungay [1964] 6 p refs Presented at the Summer Conf. of the ASME Applied Mech. Div., Boulder, Colo., 9–11 Jun. 1964
(Grant AF-AFOSR-100-63)
(AFOSR-64-2240; ASME Paper-64-APM-4; AD-452400)

Free motions of a linear elastic, nondissipative, two-degree-of-freedom system, subjected to a static nonconservative loading, are analyzed with the aim of studying the connection between the two instability mechanisms (termed

divergence and flutter by analogy to aeroelastic phenomena) known to be possible for such systems. An independent parameter is introduced to reflect the ratio of the conservative and nonconservative components of the loading. Depending on the value of this parameter, instability is found to occur for compressive loadings by divergence (static buckling), flutter, or by both (at different loads) with multiple stable and unstable ranges of the load. In the latter case, either type of instability may be the first to occur with increasing load. For a range of the parameter, divergence (only) is found to occur for tensile loads. Regardless of the nonconservativeness of the system, the critical loads for divergence can always be determined by the (static) Euler method. The critical loads for flutter (occurring only in nonconservative systems) can be determined, of course, by the kinetic method alone. Author

N65-17324# Battelle Memorial Inst., Columbus, Ohio.
LOCAL YIELDING AND EXTENSION OF A CRACK UNDER PLANE STRESS Combined Progress Report of the Ship Structure Committee
G. T. Hahn and A. R. Rosenfield Washington, NAS-NRC, Dec. 1964 27 p refs
(Contract NObs-88348)
(SSC-165; AD-432278)

The size of locally yielded regions, the stress distribution, and displacements attending a crack in tension under plane stress were calculated by extending the work of Dugdale and others. Methods were developed to take work hardening and unloading into account. The displacements and plastic-zone sizes measured in edge-slotted silicon steel coupons are found to be in agreement with calculations. Conditions under which plane stress or plane strain are dominant in these edge-slotted specimens were also determined. Finally, Irwin's fracture-toughness parameter and the conditions for crack extension are formulated in terms of basic material parameters consistent with experiment. Author

N65-17330*# Southwest Research Inst., San Antonio, Tex.
FREE VIBRATIONS OF CONICAL SHELLS
William C. L. Hu Washington, NASA, Feb. 1965 54 p refs
(Contract NASr-94(06))
(NASA-TN-D-2666) OTS: HC $3.00/MF $0.50

A method is presented for calculating the natural frequencies and associated modes of axisymmetric and nonsymmetric vibrations of truncated conical shells. The effects of transverse shear deformation and rotatory inertia are included in the formulation. The determination of the natural frequencies and mode functions is reduced to the calculation of eigenvalues and associated eigenvectors of a coefficient matrix, whose size depends on the number of terms retained in the Fourier expansions of the mode functions. Numerical examples are given to illustrate the calculation procedure. Axisymmetric vibrations of free-free conical shells are investigated based on a five-term truncation of the Fourier series of the mode functions, with special emphasis on the variation of the frequency spectrum with respect to the semivertex angle and the completeness parameter of the conical shell. Author

N65-17337# Brown Univ., Providence, R. I. Div. of Engineering
THE DYNAMIC STRESS-STRAIN RELATION OF METALS AS DETERMINED FROM IMPACT TESTS WITH A HARD BALL
C. H. Mok and J. Duffy Jun. 1964 58 p refs
(Contract Nonr-562(20)37)
(AD-603929)

An analysis is presented of the impact process occurring when a hard ball strikes the surface of a large metal specimen. It is shown that the results of dynamic indentation tests can be interpreted to provide a measure of the yield stress of the metal over a range of strains, taking into account the influence of strain rate. Experiments are described in which steel balls are allowed to drop onto specimens of lead, steel, and aluminum. In each test the velocities of impact and rebound are measured, as well as the diameter of the identation remaining in the metal specimen, and the time of contact between specimen and indenter. These experimental results are used in conjunction with the analysis to provide for each metal a dynamic stress–strain curve, which is then compared to the results of a simple compression test performed under impact conditions. For all metals, the best agreement occurs if the simple compression tests are performed at a strain rate of 1500 sec^{-1}. Author

N65-17343# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATION OF A WING OF FINITE SPAN IN SUPERSONIC FLOW
M. D. Haskind and S. V. Falkovich 11 Dec. 1963 12 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 11, 1947 p 371–376
(FTD-MT-63-132; AD-606280)

Turbulent supersonic flow past a short-span vibrating delta wing is investigated. Simultaneous integral equations are derived for a Fourier solution that admits the possibility of boundary layer turbulence in the Mach cone. E.P.V.

N65-17357# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF THE ACCUMULATION OF FATIGUE DAMAGE DURING AN ASYMMETRICAL CYCLE OF RANDOM STRESSES
V. F. Shukailo 26 Dec. 1963 21 p ref Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 12, 1962 p 21–32
(FTD-MT-63-115; AD-605882) OTS: $1.00

This work considers the problem of determining structure durability during asymmetric cycle of simple and complex forms of continuous, and also discrete, random stresses. The general formulas of durability are obtained on the basis of linear and nonlinear theories of accumulation of fatigue damage. The extremeness of the linear law of fatigue damage accumulation is established. The upper and lower limits of the durability ratio, calculated by nonlinear and linear theories of fatigue accumulation, are found for the general case of load. Author

N65-17403*# Southwest Research Inst., San Antonio, Tex. Dept. of Structural Research
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE NONLINEAR DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS Final Report
Thein Wah 31 Jan. 1965 49 p refs
(Contract NASr-94(05); SwRI Proj. 03-1435)
(NASA-CR-60802) OTS: HC $2.00/MF $0.50

This report describes experimental and theoretical work on the nonlinear vibration of uniform beams for various support conditions. The experimental work is an account of an attempt to extend the Moire´ method to dynamic problems by use of high speed photography. The theoretical work is mainly the development of a numerical procedure for investigating vibration of nonlinear beams for those cases where the space and time variables are not separable. Author

N65-17412# Pacific Naval Lab., Esquimault (British Columbia).
PRINCIPLES OF DESIGN OF CATHODIC PROTECTION SYSTEMS FOR THE HULLS OF ACTIVE SHIPS
J. A. H. Carson Sep. 1964 48 p refs
(Rept.-64-2)

An engineering approach to the design of cathodic protection systems for ships' hulls is presented. The method is applicable to all types of anode systems. The effects on current requirements of dissolved oxygen concentration, ship speed, temperature, salinity, type and condition of hull paint system, metallic bonding of rotating propellers to the hull, and efficiency of current distribution, are discussed. Methods are developed for estimating both the maximum current output capability and the safe current output of anodes, and are presented graphically for easy reference. Sample calculations are given, and the theoretical developments are supported, wherever possible, by data obtained from RCN ships. Author

N65-17447# Space Technology Labs., Redondo Beach, Calif.
APPROXIMATE INFLUENCE COEFFICIENTS OF CANTILEVERED STIFFENED THIN-WALLED CONICAL FRUSTUMS UNDER END LOAD
Ralph E. Hubka 7 Jan. 1963 20 p refs
(Contract AF 04(694)-1)
(STL-6110-7936-KU-000; BSD-TDR-63-14; AD-298795)

Approximate equations of influence coefficients for a cantilevered stiffened thin-walled conical frustum under end moment and shear are obtained with the use of membrane theory. The problem considered is one in which the large end is clamped to a rigid wall and the small end is attached to a rigid movable bulkhead. The stiffeners are located along meridians equally spaced around the circumference. Assuming that the interval between stiffeners is relatively small, the stiffener area is smeared out and the cone is then treated as one of uniform orthotropic material. It is shown that the negative coupling effect characteristic of cones of certain configurations, is more pronounced for a stiffened than for an unstiffened cone. Author

N65-17453*# California Univ., Los Angeles.
LOAD-BEARING CHARACTERISTICS OF BIAXIALLY PRESTRESSED CERAMIC PLATES
M. A. Ali, R. D. Chipman, Peter Kurtz, and W. J. Knapp Washington, NASA, Mar. 1965 21 p refs
(Grant NsG-427)
(NASA-CR-188) OTS: HC $1.00/MF $0.50

Biaxially prestressed ceramic plates were subjected to transverse loading until failure occurred. The plates were 1/2 in. × 6 in. × 6 in. in size, and the transverse load was applied normal to the center of a plate face over a 1-1/2 in. circular area. The load-bearing characteristics of ceramic plates were greatly improved by biaxial prestressing, giving an optimum increase of almost 700%. An analysis of the loading of a hypothetical uniaxially prestressed beam was presented to explain the main features of the variation of load-bearing capacity with prestress. The stiffness of prestressed plates increased with level of prestress. The failure occurring in a biaxially prestressed plate, by the loading used, was characterized by the formation of a hole by the penetrating ram. Author

N65-17460*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TENSION SHELL STRUCTURE FOR APPLICATION TO ENTRY VEHICLES
Melvin S. Anderson, James C. Robinson, Harold S. Bush, and Robert W. Fralich Washington, NASA, Mar. 1965 27 p refs
(NASA-TN-D-2675) OTS: HC $1.00/MF $0.50

The shape of a shell of revolution designed to have only tensile stresses under axisymmetric aerodynamic loadings was derived on the basis of linear membrane theory. The drag coefficient for various proportions and various values of circumferential tension is also given. The results indicate that the design of an entry vehicle based on the tension shell concept leads to desirable aerodynamic and structural characteristics, namely, high drag and low weight. Author

N65-17461*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY UNDER GROUND-HOLD CONDITIONS OF SEVERAL INSULATION SYSTEMS FOR LIQUID-HYDROGEN FUEL TANKS OF LAUNCH VEHICLES
Porter J. Perkins, Jr. Washington, NASA, Mar. 1965 27 p refs
(NASA-TN-D-2679) OTS: HC $1.00/MF $0.50

Three proposed insulation systems that may be applied externally to the liquid-hydrogen fuel tank of launch vehicles were investigated under ground-hold conditions to determine the application feasibility to flight-weight tanks. Experimental data were obtained on the thermal performance of an uninsulated tank and of tanks with three different insulation systems—sealed corkboard bonded to the tank, sealed and evacuated polyurethane foam held in place on the tank with a constrictive wrap of prestressed nylon strands, and sealed and evacuated polyurethane foam with a film of liquid nitrogen sprayed on the external surface. Boiloff rates and overall coefficient of heat transmission for an uninsulated aluminum propellant tank were determined under ambient atmospheric conditions. The insulation effect of a layer of ice and frost on the bare tank was also measured. The sealed and evacuated polyurethane foam held in place on the tank with a constrictive wrap proved to be the best insulation system, producing a low unit weight (0.26 lb/sq ft) and low apparent thermal conductivity (0.1(Btu)(in.)/(hr)(sq ft)(° R)). The use of a sprayed-on film of liquid nitrogen over the foam insulation resulted in very low heat inflow rates of 30 Btu/(hr) (sq ft) compared with 156 Btu/(hr)(sq ft) for sealed polyurethane foam. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-16341# Case Inst. of Tech., Cleveland, Ohio.
AN INVESTIGATION OF TRANSIENT MELTING ABLATION AT THE SURFACE OF A DECELERATING SPHERICAL BODY
Dudley George Mc Connell (Ph.D. Thesis) 1964 102 p refs
Sponsored in part by AF

The transient melting ablation of a glassy material is studied both analytically and experimentally. A new perturbation analysis is presented, and the analysis of Ostrach, Goldstein, and Hamman is modified. The results of these analyses are then compared with the results of experiments

on a spherical asphalt body conducted in a vertical wind tunnel. The spherical body is used because of its relevance to the lektite problem; the vertical tunnel is used so that the gravitational force can simulate the deceleration force on a reentry body. On the basis of comparison with experimental data it can be concluded that the perturbation solution accurately describes the initial period of melting and that the quasi-steady analysis describes the long-time situation. In general, it was found that the process could be described in terms of parameters first developed by Ostrach and coworkers.
Author

N65-16438*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF HEAT-TRANSFER EFFECTS IN ROCKET NOZZLES OPERATING WITH VERY HIGH-TEMPERATURE HYDROGEN
John R. Howell, Mary K. Strite, and Harold E. Renkel Washington, NASA, Feb. 1965 34 p refs
(NASA-TR-R-220) OTS: HC $2.00/MF $0.50

An analytical technique, suitable for the solution of complex energy transfer problems involving coupled radiant and convective energy transfer, is developed. Solutions for the coupled axial-wall energy flux distribution in rocket nozzles using hydrogen as a propellant are presented. Flow rates and temperatures studied are near those forecast for gaseous-core nuclear-propulsion systems. Parameters varied are nozzle shape, inlet propellant temperature, mean reactor cavity temperature, and nozzle wall temperature level. The effects of variation of the propellant radiation-absorption coefficient with pressure, temperature, and wavelength are presented, and real property variations are used where they appear to be significant. Comparision is made to a simplified, coupled solution using a modified second-order one-dimensional diffusion equation for the radiative transfer. At the temperature levels assumed, radiative transfer may account for a greater portion of the total energy transfer over important portions of the nozzle, and its effects cannot be neglected.
Author

N65-16452*# National Aeronautics and Space Administration, Washington, D.C.
ON METHODS AND DATA REQUIRED FOR HEAT SHIELD CALCULATIONS [METHODES ET DONNEES NECESSAIRES AUX CALCULS D'ECRAN DE CHALEUR]
Georges Mounis Feb. 1965 32 p Transl. into ENGLISH from Sud-Aviation (Paris), Doc. No. 68.515/64
(NASA-TT-F-294) OTS: HC $2.00/MF $0.50

Weight and size calculation methods are presented for heat-sink and ablation types of heat shielding for protection of nozzles and payloads. Assuming the type has been selected in the preliminary design, equations are derived for structural calculations based on standard thermokinetic methods, considering heating conditions and thermal properties of the shield material as variables. Problems raised by mechanical and thermal stresses are ignored. Finite difference digital computation methods are presented. Effects of thermal loading and thermal properties of materials are discussed. The basic assumptions of this design method are these: (1) Fourier's equation applies to every point within the material, (2) Fourier's hypothesis applies to the boundaries, and (3) conductivity and specific heat depend only on temperature.
E.P.V.

N65-16473# National Bureau of Standards, Washington, D.C.
TABLES OF IDEAL GAS THERMODYNAMIC FUNCTIONS FOR 73 ATOMS AND THEIR FIRST AND SECOND IONS TO 10,000° K
Joseph Hilsenrath, Carla G. Messina, and William H. Evans Kirtland AFB, N. Mex., AF Weapons Lab., [1964] 435 p refs
(Contract DO-29(601)-60-4491)
(AFWL-TDR-64-44; AD-606163)

The tables are given at 100° intervals starting at 100° K for the atoms, and at 100° or 1000° for the ions and extending to 10000° K. They were computed for the atoms and atomic ions considered as ideal monatomic gases by direct summation over the available energy levels. The summation over energy levels was made from the ground state up to the principal quantum number 5. Where the quantum number, n, for the ground state exceeds 5, summations were made only over levels having the same n as the ground state. The sensitivity of the thermal functions to the inclusion of higher energy states in the partition function is discussed briefly, illustrated graphically for the specific heats, and tabulated for the Gibbs free energy function.
Author

N65-16590*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL COMPARISON OF RELATIVE HEAT-TRANSFER COEFFICIENTS AND PRESSURE DROPS OF INERT GASES AND THEIR BINARY MIXTURES
Michael R. Vanco Washington, NASA, Feb. 1965 17 p refs
(NASA-TN-D-2677) OTS: HC $1.00/MF $0.50

This analysis was conducted to determine and compare the relative heat-transfer coefficients and pressure drops of the inert gases and their binary mixtures. The required transport properties were determined from kinetic theory correlations, and the relative heat-transfer coefficients and pressure drops were determined from commonly used heat-transfer and pressure-drop equations. The relative heat-transfer coefficients and pressure drops of the binary mixtures cannot be obtained by common averaging methods from the pure gas values. For a given molecular weight, the heat-transfer coefficients of the binary mixtures are higher than those of the pure component for both laminar and turbulent flow, and the pure component. The nature of the laminar-flow pressure-drop relation precludes any generalization. The substitution of a higher-molecular-weight binary gas mixture for a pure gas in a gas cycle system can result, in many cases, in more favorable turbomachinery and, at the same time, an improvement in heat-transfer performance.
Author

N65-16591*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF UNCERTAINTIES IN THE THERMAL CONDUCTIVITY OF AIR ON CONVECTIVE HEAT TRANSFER FOR STAGNATION TEMPERATURE UP TO 30,000° K
John T. Howe and Yvonne S. Sheaffer Washington, NASA, Feb. 1965 43 p refs
(NASA-TN-D-2678) OTS: HC $2.00/MF $0.50

Convective heat transfer is examined for earth entry speeds up to 85000 ft/sec corresponding to a stagnation region temperature of approximately 30000° K. There is considerable uncertainty in the total thermal conductivity of air at temperatures above 15000° K. The effect of this uncertainty on convective heat transfer is studied. Correlation formulas for the thermodynamic and transport property parameters used in the analysis are presented as functions of enthalpy for pressure levels 0.1, 1.0, and 10 atm. These include density, temperature, and parameters involving viscosity, Prandtl number (for three models of total thermal conductivity), and the Planck mean mass absorption coefficient for gaseous radiation. These property correlations are presented in a form useful for digital computer programs.
Author

N65-16631# Argonne National Lab., Ill. Reactor Engineering Div.
THE CONTROL OF CONDENSATION HEAT TRANSFER RATES USING AN ELECTROMAGNETIC FIELD
Ralph M. Singer Jul. 1964 85 p refs
(Contract W-31-109-ENG-38)
(ANL-6861) OTS: $5.00

The use of an electromagnetic field to control the laminar film condensation of a vapor whose liquid is electrically conducting is proposed and analyzed. The condensate is pumped down a vertical wall by the field (similar to the action of an electromagnetic pump), thus eliminating the necessity of gravity without introducing moving parts. The effect of the parameters $c\Delta T/h_{fg}$, Pr, $g(\rho-\rho_v)/\sigma B_0 E_0$, $(E_0/B_0)^2/h_{fg}$, and ζ (dimensionless coordinate) upon the condensate film thickness and the heat-transfer rate is studied. It is found that when an electromagnetic field is used, the rate of condensation can be significantly increased over that obtained when only the gravitational field is used. For example, the ratio of the condensation Nusselt number with gravitational and magnetic fields to that with only a gravitational field is about 10 for sodium when $c\Delta T/h_{fg} = 0.001$, $B_0 = 20$ kilogauss, and $E_0 = 10$ volts per inch. Author

N65-16643# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe
TEMPERATURE MEASURMENTS IN COMBUSTION GASES BY MEANS OF THERMOCOUPLES [TEMPERATUR-MESSUNGEN MIT THERMOELEMENTEN IN VERBRENNUNGSGASEN]
W. Alvermann and P. Stottmann Jul. 1964 39 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-18) Available from ZLDI, Munich: 8 DM

For temperature measurements in combustion gases by means of thermocouples, corrections are suggested which compensate errors due to the velocity of the fluid, radiation, and heat conduction. Moreover, the possible errors by catalytic effects when using thermocouples from precious metals are studied. Experimental results for different probes show that the corrected values are in good agreement. Finally, a method is described for electrically eliminating the radiation error by a resistance heating. Author

N65-16659# Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF GALLIUM PHOSPHIDE, INDIUM PHOSPHIDE, AND INDIUM SULFIDE
L. B. Pankratz 1965 11 p refs
(BM-RI-6592)

Heat content measurements were conducted for $GaP_{0.996}$ over the temperature range from 298° to 1100° K, and for $In_2S_{2.897}$ over the range from 298° to 1200° K. Both the actual experimental data and values adjusted to conform with the stoichiometric compositions (GaP, InP, and In_2S_3) were reported. Entropy increments above 298.15° K were calculated for the stoichiometric compounds, and heat content and heat capacity equations were derived. Autbor

N65-16671# Space Technology Labs., Redondo Beach, Calif.
EFFECT OF ABLATION ON MOMENTUM DEPOSITION IN THE WAKE OF A RE-ENTRY VEHICLE
A. G. Hammitt 15 Aug. 1964 9 p
(Contract AF 04(694)-637)
(STL-6453-6005-TU000; BSD-TDR-64-121; AD-451773)

The effects of the loss of momentum of an ablating vehicle caused by the mass loss were analyzed. It is shown that while the total momentum loss is always larger for the nonablating vehicle, it cannot exceed twice the loss caused by the friction drag on the nonablating vehicle during the laminar flow regime. Author

N65-16676# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF HEAT TRANSFER AND HYDRAULICS OF TWO PHASE MEDIA Collection of Articles
S. I. Mochan, ed. 31 Aug. 1964 434 p refs Transl. into ENGLISH of the book "Teplootdachi i Gidravliki Dvukhfaznykh Sred" Moscow, Gos. Energ. Izd., 1961 p 1-392
(FTD-MT-64-371; AD-608079)

Articles on problems of heat transfer and hydraulics of liquid-gas systems. For individual titles see N65-16677-N65-16698.

N65-16677 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMILARITY CONDITIONS FOR PROCESSES OF TRANSMISSION OF HEAT WITH VARIABLE PROPERTIES OF LIQUID
I. I. Novikov *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 6-14 refs (See N65-16676 07-33)

Different substances satisfying the same law of corresponding states are called thermodynamically similar. General functional dependences for coefficients of viscosity and thermal conductivity were obtained from fundamental equations of motion by the theory of similarity. Similarity laws for heat transfer in fluid flow of substances with variable physical properties, in particular variable coefficients of viscosity and thermal conductivity, are developed. For total similarity of processes of transmission in different liquids, it is necessary that (1) the liquids are thermodynamically similar; (2) they are in corresponding states; and (3) they have equal values of similarity criteria, characterizing conditions on the boundary "liquid-solid." E.E.B.

N65-16678 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THEORY OF THERMODYNAMIC SIMILARITY TO PHENOMENON OF CRISIS DURING BOILING OF LIQUID
I. I. Novikov *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 15-19 refs (See N65-16676 07-33)

For thermodynamically similar substances, boiling is described by dimensionless equations containing reduced parameters. An expression for thermal flux density at the boiling point is developed. Experimental results are compared with those calculated according to the theory of thermodynamic similarity. On the basis of these comparisons, it was concluded that it is necessary to introduce thermodynamic similarity as a condition of similarity of heat exchange, mass transfer, and other similar processes. E.E.B.

N65-16679 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF INFLUENCE OF PRESSURE ON HEAT TRANSFER AND CRITICAL LOADS DURING BOILING ON BASIS OF THEORY OF THERMODYNAMIC SIMILARITY

V. M. Borishanskiy *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 20–41 refs (See N65-16676 07-33)

A thermodynamic method is developed of generalization of the physical characteristics of working media, the coefficients of heat transfer, and critical loads during boiling. The method proposed may also be used for generalization of other processes of convective heat exchange which occur in working media at the point of saturation. E.E.B.

N65-16680 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF CRITICAL THERMAL LOADS DURING FLOW OF WATER IN ROUND PIPE

V. Ye. Doroshchuk and F. P. Frid *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 42–51 refs (See N65-16676 07-33)

Thermal load was experimentally determined by current intensity and voltage drop along an experimental pipe in which the working fluid flowed. The instant of boiling was established by the local sharp reddening of the experimental pipe, caused by a rise in temperature of the pipe wall. It was shown that critical thermal load is independent of the length of the heating time, wall thickness, type of electric current, and degree of roughness of the wall. For very short channels, a small increase of critical thermal load was observed. As the pipe length was increased, critical load remained constant. This indicated that except for the very short channel, critical thermal load was independent of the length of the heating surface. E.E.B.

N65-16681 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRITICAL THERMAL FLUXES DURING FORCED MOTION OF STEAM-WATER MIXTURE IN PIPE

O. L. Peskov, V. I. Subbotin, B. A. Zenkevich, and N. D. Sergeyev *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 52–64 refs (See N65-16676 07-33)

Critical thermal flux was attained by slow increase of electrical power in the working section of a stainless steel pipe. The instant of attainment was fixed by local increase of the pipe wall temperature. The working section was divided into a section in which heating occurred and a section in which water was evaporated. Experimental data were expressed in the form of graphs. It was shown that critical thermal flux decreased with increase in mass steam content for investigated pressure and flow rates. A comparison made of experimental values with those from theory gave higher experimental values, especially at large steam content. Possible causes for the deviations are mentioned. E.E.B.

N65-16682 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRITICAL THERMAL LOADS DURING FREE CONVECTION AND FORCED MOTION OF BOILING AND UNDERHEATED DOWTHERM

S. S. Kutateladze and B. A. Burakov *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 65–87 refs (See N65-16676 07-33)

The main advantages of organic heat-transfer agents are their high boiling points at atmospheric pressure. Dowtherm, a eutectic and azeotropic mixture of diphenyl (26.5%) and diphenyl ether (73.5%), with a solidification temperature of 12.3° C, a boiling point at atmospheric pressure of 258° C, a critical temperature of 528° C, and a critical pressure of 41 atm was used in the experiment. Dowtherm has a sharp characteristic odor and light brown color, is not toxic, does not have a corrosive effect on carbon steel, is combustible but not explosive. Experimental measurements were made of critical thermal loads during free convection of Dowtherm in a large volume, and during forced flow in a slotted channel. Data and results are presented. E.E.B.

N65-16683 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER DURING BOILING OF WATER AND ETHYL ALCOHOL ON EXTERNAL SURFACE OF PIPES (IN LARGE VOLUME)

V. M. Borishanskiy, G. I. Bobrovich, and F. P. Minchenko *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 88–107 refs (See N65-16676 07-33)

The intensity of heat transfer to a boiling liquid is determined by thermal load of the heating surface, pressure, physical properties of the boiling liquid, and the physics of the liquid-surface interface. Measurements of heat transfer were made on water and ethyl alcohol at pressures of 1.03 Kg/cm^2 to 100 Kg/cm^2 and at thermal loads from 50×10^3 to 10^6 kilocalories/m^2. Results of experiments show that the influence of pressure on heat transfer during boiling is expressed by a complex dependence which cannot be represented by a simple exponential function with constant exponent for pressure. Data are presented in graphic form and tables. E.E.B.

N65-16684 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER DURING BOILING OF REFRIGERANTS

G. N. Danilova *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 108–131 refs (See N65-16676 07-33)

A comparison of experimental data is made to establish formulas for calculation of coefficients of heat transfer for Freon-11 and Freon-12. Heat transfer during boiling is divided into three types: (1) boiling in a large volume with free motion of the liquid; (2) boiling in a large volume with forced motion; and (3) boiling inside tubes. Heat transfer during boiling in a large volume with conditions of free convection and heat transfer during boiling in horizontal tubes are discussed. It is concluded that heat exchange during the boiling of refrigerants in a large volume obeys the dependence of other liquids. The results of boiling of Freon-11 and Freon-12 inside tubes gives a more or less coinciding characterization of the qualitative picture of the process. By consideration of experimental data, empirical values are determined which can be applied to the calculation of coefficients of heat transfer for Freon-11 and Freon-12 inside horizontal tubes. Calculating formulas, only to a certain degree, reflect the complicated and still insufficiently studied process of heat exchange during boiling of refrigerants. E.E.B.

N65-16685 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER DURING BOILING OF WATER-AMMONIA SOLUTIONS

V. N. Filatkin *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 132–136 refs (See N65-16676 07-33)

Heat transfer experiments during the boiling of a water–ammonia solution were made in a horizontal tube; 28 mm in diameter and 450 mm in working section length. On the basis of experimental data, a graph was prepared for a number

of thermal loads, and an empirical formula was derived. The following were concluded: (1) Magnitudes of heat transfer coefficients during boiling of water–ammonia are not connected additively with values of coefficients of heat transfer of pure liquids comprising the solution. Coefficients of heat transfer for the boiling of ammonia–water solutions are significantly lower than for boiling of water and ammonia. (2) One of the causes of the impairment of heat transfer during boiling of water–ammonia solutions is a decrease in the number of vaporization centers. (3) Heat transfer during boiling of solutions is determined by specific thermal flux, solution concentration, and saturation temperature or pressure. Heat transfer during boiling of water–ammonia solutions is very slowly intensified by increase in pressure. E.E.B.

N65-16686 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER TO WATER AND WATER SOLUTIONS OF SALTS OF LITHIUM DURING NUCLEATE BOILING IN LARGE VOLUME

F. P. Minchenko and E. V. Firsova *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 137–150 refs (See N65-16676 07-33)

An investigation was made of heat transfer during boiling in a large volume of water and water solutions of lithium bromide and lithium chloride. Thermal load, pressure, and salt concentration were the parameters varied during the experiment. The experimental apparatus was a welded drum, 200 mm in diameter and 500 mm in length, with a horizontal tube inserted along the axis. Visual observations were made at 150-mm diameter windows in the lateral walls of the apparatus. During the experiment, the temperature of fluid and tube, the voltage drop and current strength in the working section, and the pressure of fluid vapors were the parameters measured. The coefficient of heat transfer was calculated from these measurements, and the results are presented in tables and graphs. E.E.B.

N65-16687 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL RESEARCH OF HEAT TRANSFER DURING FILM BOILING OF A FLUID IN HORIZONTAL AND VERTICAL TUBE IN A LARGE VOLUME

V. M. Borishanskiy *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 151–161 refs (See N65-16676 07-33)

A photograph of the film boiling of ethyl alcohol on a horizontal and on a vertical graphite rod is shown as a qualitative example. The character of flow depends on the magnitude of thermal load. With the increase of thermal load, the stability of the vapor layer is increased. Vapor is detached from the upper parts of the horizontal tube when the thermal load is small. With an increase in thermal load, the line of breakaway moves nearer the lower part of the apparatus. During film boiling of a vertical surface, vapor surrounds it with a thin film on which large vapor bubbles collect. The path of this motion is in the form of a helix. Pulsation of the vapor layer at the surface was observed. The influence of physical properties of the liquid on heat transfer was observed. A comparison of data for horizontal and vertical tubes shows that noticeable divergence takes place for small thermal fluxes, i.e., in the region of unstable film boiling. In the region of steady-state film boiling, the magnitude of the coefficients of heat transfer are close. E.E.B.

N65-16688 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER DURING FILM CONDENSATION OF VAPOR INSIDE A HORIZONTAL TUBE

S. S. Kutateladze *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 162–180 refs (See N65-16676 07-33)

Experimental results with high-pressure vapor indicate that with large thermal loads and high densities of vapor, condensate film flow basically is caused by vapor and not gravity. The lower the pressure, the higher is the coefficient of heat transfer. The intensity of heat transfer increases sharply with the increase of tube length. Results of experiments with high-pressure vapor, unlike that of low-pressure vapor, show the great influence of vapor flow velocity on heat transfer intensity through the condensate film. Further, calculations show that under conditions of intense condensation of high-pressure vapor, the condensate film flow through the tube must be turbulent. The theory of heat transfer of rapidly moving vapor during turbulent condensate film flow is given. E.E.B.

N65-16689 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL RESEARCH ON HEAT TRANSFER DURING CONDENSATION OF MERCURY VAPOR

L. I. Gel'man *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 181–201 refs (See N65-16676 07-33)

One important factor determining heat exchange between a solid wall and a substance during change of state is the property of being moistened. If the condensate moistens the cooling surface, then condensation will be a film, and if it does not moisten it, it will be dropwise. Mercury does not moisten steel surfaces; therefore, dropwise condensation was expected in this experiment and was observed. Filming of the process of condensation was simultaneous with recording of all data. It was therefore possible to connect data with qualitative characteristics of the heat exchange process. Photographs are presented to illustrate the qualitative characteristics of the mercury condensation process. The dependence of coefficient of heat transfer on temperature pressure and of heat flux on pressure vapor speed are presented as graphs. E.E.B.

N65-16690 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ORGANIC HEAT-TRANSFER AGENTS AND PROSPECTS OF THEIR APPLICATION IN REACTORS

Ye. P. Anan'yev *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 202–223 refs (See N65-16676 07-33)

The basic requirements for organic compounds to be used as coolants in nuclear reactors are high boiling point and low fusion temperatures, low vapor elasticity at high temperature, nonexplosive quality, inertness with respect to structural metals, high thermal stability, radiation stability in liquid and vapor phase, and low cost. Hydrocarbons have low volatility, do not react with structural metals or uranium, and contain no oxygen. These characteristics, together with a small neutron-capture cross section, make these compounds acceptable for use as a coolant and moderator. Among the deficiencies of organic coolants are their decomposition, thermal instability, and low fusion temperature in some cases and high fusion temperature in others, which leads to crystallization in the system. The properties of diphenylmethane, diphenyl–diphenyl ether eutectic, and silicone compounds are presented. Diphenyl has shown high stability under electron beam radiation. Also, the products generated as a result of any disintegration are not precipitated on the cold or hot walls of the system. E.E.B.

N65-16691 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF EFFECTIVE HEADS IN BOILER TUBES
O. M. Baldina and D. F. Peterson *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 225–284 refs (See N65-16676 07-33)

The hydrodynamic calculations in boilers with natural circulation, and the determination of resistances of steam-containing elements of boilers with forced motion of the working fluid are based on experimental data on effective heads of risers and resistances of horizontal tubes. Data are presented in graphic form for the effective heads of vertical and slanted tubes, and for horizontal tube resistances for varying steam velocities, demonstrating how parameters vary with change in dependencies. Analytical results of the study are shown in the form of nomographs. E.E.B.

N65-16692# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL RESEARCH ON NET PRESSURE HEADS IN PIPES AT ZERO AND LOW SPEEDS OF WATER
S. I. Mochan, M. M. Przhiyalkovskiy, L. L. Bachilo, and I. N. Petrova *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 285–303 refs (See N65-16676 07-33)

The construction of experimental apparatus for moving pressure head research at zero and flow rates of water close to zero is described. Circulatory characteristics were taken and measurements were made at low water velocity in the region of stagnation for pipes, 76 × 8 mm and 40 × 4.5 mm in diameter, at pressures of 64, 108, 144, and 185 atmospheres. Nearly 280 experimental points were obtained, basically on unheated pipes. Experiments on the study of pressure heads of stagnation were also conducted. Experimental values are given of true steam contents in pipes 60 mm and 63 mm at zero rate of water at outlet. The dependence of true steam content on steam speed and pressure in unheated pipes is presented in graphic form. If the flow rate of water at the outlet is equal to zero in an evenly heated pipe, then the average flow rate of water in the pipe is equal to the average flow rate of steam.
E.E.B.

N65-16693 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOCAL RESISTANCES DURING MOTION OF TWO-PHASE MIXTURES
S. I. Mochan *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 304–349 refs (See N65-16676 07-33)

The resistances of collectors with dispersed feed and branching, and the resistances or branch pipes and elbows were investigated for air–water and steam–water mixtures at various pressures. Experiments for the air–water mixture were conducted on a multitubular model, i.e., a model of a collector with a large quantity of inlet and outlet pipes. The model for the steam–water mixture was simplified. Diagrams of the experimental apparatus are presented. Water velocity for the air–water experiment was varied within the limits of 0.1 to 1.6 m/sec, air velocity from 0.5 to 15 m/sec, and pressure from 1.2 to 2.2 atm. Experiments with the steam–water mixture were conducted at 10 to 200 atm. It was concluded that if a vertical or inclined section of pipe is located after the elbow, the loss of pressure due to the turn is a few times higher for the mixture than for the single-phase media. Drag coefficients of elbows with sequent horizontal sections of pipe are the same for a mixture or for a single medium. Based on the experimental data and analysis, drag coefficients for various situations found in piping are given. E.E.B.

N65-16694 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE HYDRODYNAMIC STABILITY OF CERTAIN LIQUID-GAS SYSTEMS
S. S. Kutateladze and Yu. L. Sorokin *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 350–357 refs (See N65-16676 07-33)

Formulas determining the approach to critical conditions during the interaction of liquid–gas flow are considered. Thirteen different processes are tabulated with the theoretical or experimental formula, the bibliographic source, and reduced formula. Diagrams are also presented, illustrating each process considered. It is concluded that from the comparisons made, the coincidence of calculated and experimental values is fully satisfactory. E.E.G.

N65-16698 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASIC REGULATED PARAMETERS OF DRUM BOILERS UNDER NON-STATIONARY CONDITIONS
L. S. Shumskaya *In its* Probl. of Heat Transfer and Hydraulics of Two Phase Media 31 Aug. 1964 p 387–427 refs (See N65-16676 07-33)

Formulas are developed for the determination of the rate of change of steam pressure, the temperature change for superheated steam, and the volume of steam under evaporation surfaces for drum boilers under nonstationary conditions. An experimental check confirmed the validity of the formula for the change of pressure. It was concluded that calculations for a large quantity of boilers, typical for Soviet power engineering, will help in estimating the properties of boilers of other types. E.E.B.

N65-16710# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe
AERODYNAMIC FLAME STABILIZING [AERODYNAMISCHE FLAMMENSTABILISIERUNG]
W. Alvermann and R. Ulken Sep. 1964 34 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-26) Available from ZLDI, Munich: 7.50 DM

An advanced procedure for flame stabilizing in combustion chambers is described and compared with the conventional mechanical flame holders. This aerodynamic flame stabilization offers the advantages of an improved efficiency and a control possibility. In special investigations, a combustion chamber with single compressed air jets directed obliquely toward the main flow proved to be suitable as a means for flame stabilizing on a large scale with good efficiency. Model measurements are made in order to obtain data for combustion chambers with aerodynamic flame stabilization. Author

N65-16750*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER TO LAMINAR NON-NEWTONIAN FLOW IN A CIRCULAR TUBE WITH VARIABLE CIRCUMFERENTIAL WALL TEMPERATURE OR HEAT FLUX
Robert M. Inman Washington, NASA, Feb. 1965 24 p refs (NASA-TN-D-2674) OTS: HC $1.00/MF $0.50

An analysis is presented for fully developed heat transfer for laminar flow of a power-law non-Newtonian fluid in a circular tube with arbitrary circumferential wall temperature or heat flux. The results allow calculation of temperature or wall heat-flux variations for various velocity profiles when the tube has a uniform axial heat input and an arbitrary peripheral wall-temperature or heat-flux variation. The circumferential

variation of Nusselt modulus with respect to these temperature or heat-flux variations and velocity profiles is shown. It is found that heat-transfer analyses based on the assumption of a parabolic velocity distribution will introduce serious errors when the fluid exhibits a nonlinear shearing-stress–shearing-rate relation, so that the actual behavior of the velocity profile must be considered. Author

N65-16787# AVCO-Everett Research Lab., Everett, Mass.
CARBON AND GRAPHITE BURNING IN HIGH SPEED FLOWS OF COMBUSTION GASES
W. Baumann, J. C. Chato, and L. R. Di Nanno Dec. 1964 58 p refs
(AVCO-Everett Res. Rept.-203)

The burning of carbon and graphite was studied in high-speed flows of combustion products. Experimentally, burning rates were found as a function of mass flow rate and composition of the combustion gases and as a function of the surface temperature of the carbon samples. The effect that the addition of artificial ash and seed to the combustion gases have on the rate of carbon burning was also tested. All grades of graphite tested were found to burn at approximately the same rate. The relatively large temperature dependence on the burning rate points to the chemical reactions on the surface as the major rate limiting process. It was concluded that a large part of the reaction must take place within the porous structure of the samples. An attempt was made to extend the usefulness of the experimental results to other conditions of surface temperature, gas flow rate, and gas composition. Author

N65-16890*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL INVESTIGATION OF PEAK AND AVERAGE HEATING EFFECTS IN CASCADE-ARC JET
W. D. Beasley, R. L. Barger, and J. D. Brooks Washington, NASA, Feb. 1965 22 p refs
(NASA-TN-D-2653) OTS: HC $1.00/MF $0.50

The results of a systematic investigation of some gas heating characteristics of a supersonic arc jet are presented. The gas heating mechanism was a constricted arc in the throat of a cascade nozzle arrangement. The effects of varying the arc current, pressure, and flow medium on the ejection velocity and settling-chamber pressure rise were measured. To the extent that the ejection velocity can be related to the peak throat temperature, and the settling-chamber pressure to the average throat temperature, the results are consistent with experimental and analytical studies of stationary arcs. Author

N65-16903# Atomic Weapons Research Establishment, Aldermaston (England).
THE EQUATION OF STATE OF COPPER AND OF OTHER METALS NEAR THEIR CRITICAL POINTS
E. Morris Jul. 1964 50 p refs
(AWRE-O-36/64)

A method is developed for finding a relationship between the pressure, specific internal energy, and density of metals for a range of these thermodynamics variables enclosing the critical point. A relation of the Grüneison form, $p = \rho\gamma(\rho)\,[\epsilon - \epsilon_0(\rho)]$, is assumed, and values of the two parameters in this equation are given for copper for densities between 10 and 0.1 g/cc. A method of describing the partially vaporized metal is given. Author

N65-17074*# Princeton Univ., N. J.
ANALYTICAL INVESTIGATION OF SEVERAL MECHANISMS OF COMBUSTION INSTABILITY
Warren C. Strahle and L. Crocco [1963] 25 p refs Presented at the 5th Liquid Propulsion Meeting, Tampa, Fla., 15 Nov. 1963
(Grant NsG-99-60)
(NASA-CR-52632) OTS: HC $1.00/MF $0.50

Some possible causes of combustion instability in liquid propellant rocket engines have been analytically investigated by small perturbation analysis. The mechanisms under consideration are (1) the oscillatory burning or vaporization of liquid droplets when based upon quasi-steady theories of vaporization, (2) the effect of droplet displacement from mean positions caused by drag oscillations, and (3) the oscillation of the mean injected drop size, distribution function, or droplet number flow rate caused by chamber gas pressure oscillations at the injector face. These possible causes are investigated within the framework of what is known concerning the gasdynamic problem of an unstable rocket engine. A brief review is given concerning the fundamentals of high-frequency instability. The requirements of a true mechanism or forcing function for the wave propagation problem are pointed out. Author

N65-17087# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONNECTION OF AERODYNAMIC HEAT WITH SKIN FRICTION
L. V. Kozlov 1 Dec. 1964 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1963 p 108–111
(FTD-TT-64-377/1+2; AD-609788)

Experiments were conducted in the same wind tunnel under the same temperature conditions for the determination of heat transfer and skin friction in order to derive a more accurate dependence between heat tansfer and friction in the supersonic flow of gas flowing over a flat plate. The standard deviation of experimental points from interpolated curves did not exceed 10%. Experimental values are compared with those calculated by empirical formulas. E.E.B.

N65-17100*# California Univ., Berkeley.
INFRARED RADIATION MEASUREMENTS OF COMBUSTION GASES Second Quarterly Progress Report, Oct. 1–Dec. 31, 1964
M. M. Abu-Romia, L. S. Wang, and W. H. Giedt 15 Jan. 1965 18 p refs
(Contract NAS8-11468)
(NASA-CR-60714) OTS: HC $1.00/MF $0.50

The fabrication of alumina tube window holders and their installation in the high-temperature infrared absorption system is described. Measurements of the temperature distribution along the test optical path with these holders showed the variation to be reduced to 80° K for a center temperature of 1200° K. Absorption measurements of CO at 1200° K and pressures of 0.25 to 3 atmospheres are presented. These are successfully correlated by the strong line approximation in the Elsasser band model. Author

N65-17101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EMPLOYMENT OF PELLICULAR SENSING ELEMENTS TO STUDY HEAT EXCHANGE IN A DISSOCIATED GAS FLOW

Yu. A. Polyakov 14 Nov. 1964 16 p refs Transl. into ENGLISH from Fiz. Gazodinam., Teploobmen i Termodinam. Gaz. Vysokikh Temp., Energ. Inst., Akad. Nauk SSSR, 1962 p 251–260 refs
(FTD-TT-63-1056/1+2; AD-608602)

A method for the experimental investigation of heat transfer problems in a laminar layer of dissociated gas with consideration of diffusion is presented. Pellicular sensing elements are used, relations are developed, and formulas presented for solution of heat transfer parameters. E.E.B.

N65-17124# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering
BIBLIOGRAPHY OF SQUID PUBLICATIONS, OCTOBER 1963–SEPTEMBER 1964
Nov. 1964 41 p refs
(Contract Nonr-3623(00); Proj. SQUID)
(UVA-6-R; AD-609240)

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5. ENGINES AND PROPULSIVE SYSTEMS R. L. Leonard et al p 33–34
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N65-17208# RAND Corp., Santa Monica, Calif.
THE THERMODYNAMICS OF THE POLYAMIDE RESIN (NYLON-6): CARBON-HYDROGEN-OXYGEN-NITROGEN VAPOR SYSTEM
F. J. Krieger Jan. 1965 35 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4404-PR; AD-609882)

The thermodynamic investigation of polyamide resin (Nylon-6) over a range of temperatures up to 6000° K and pressures up to 10^5 atmospheres is described. Two sets of equilibrium composition equations are used—one representing a pure gas phase, the other a heterogeneous system of gas and solid carbon. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 90 gaseous carbon–hydrogen–oxygen–nitrogen species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight. Author

N65-17283*# National Bureau of Standards, Boulder, Colo.
THERMAL CONDUCTIVITY OF TEN CRYOGENIC LIQUIDS—A BIBLIOGRAPHY
L. A. Hall 15 Apr. 1963 21 p refs
(NASA Order R-45; NBS Proj. 8140-40-81450; NBS Proj. 8140-40-81141)
(NASA-CR-50292; NBS-7684) OTS: HC $1.00/MF $0.50

This bibliography contains 73 citations concerning the thermal conductivity of the following liquids: helium-3, helium-4, hydrogen, parahydrogen, deuterium, neon, air, fluorine, oxygen, nitrogen, argon, carbon monoxide, and methane. The information given in each citation includes author, title, reference, and subject and descriptor terms. In addition, the article is coded as to language, temperature range, form of data (numeric, graphic), type of article (experimental, review or compilation, theoretical, etc.), and general availability of the document. An index by fluid and an index by author are included to facilitate reference to pertinent documents which are listed serially by accession number. Author

N65-17292# Los Alamos Scientific Lab., N. Mex.
IDEAL GAS THERMODYNAMIC FUNCTIONS OF LANTHANIDE ELEMENTS
Roy C. Feber and Claude C. Herrick 5 Feb. 1965 37 p refs
(Contract W-7405-ENG-36)
(LA-3184) OTS: $2.00

Experimental and, in some cases, predicted energy level data are used to calculate the thermodynamic functions of the gaseous monatomic lanthanide elements cerium through lutetium and the gaseous monatomic actinide elements thorium through curium over the temperature range of 100° to 6000° K. Author

N65-17316*# National Bureau of Standards, Boulder, Colo.
A BIBLIOGRAPHY OF THERMOPHYSICAL PROPERTIES FOR FLUORINE FROM 0° TO 300° K
L. A. Hall and R. D. Mc Carty 1 Apr. 1963 24 p refs
(NASA Order R-45)
(NASA-CR-50285; NBS-7676) OTS: HC $1.00/MF $0.50

This bibliography of thermophysical properties for fluorine from 0° to 300° K presents 51 citations which include author, title, reference, properties studied, temperature and pressure ranges, state of substance, type of data presented (i.e., whether the data are derived from experimental measurements, theoretical considerations or as a compilation from other sources), the form and amount of data. An index according to property, subindexed for state of substance, is included. Author

N65-17348# Harvard Univ., Cambridge, Mass. Gibbs Chemical Lab.
THE MECHANISM OF THE ACETYLENE-OXYGEN REACTION IN SHOCK WAVES
G. P. Glass, G. B. Kistiakowsky, J. V. Michael, and H. Niki Aug. 1964 47 p refs Submitted for Publication
(Contract Nonr-1866(36))
(AD-445101)

The oxidation of acetylene was studied using sufficiently high gas densities and concentrations of inert gas to keep the reaction isothermal and to reduce boundary layer effects. The induction periods and exponential time constants of the oxidation were measured using the observations of (1) chemiluminescense and gas conductivity in incident and in reflected shock waves; and (2) total ionization and product formation using a time-of-flight mass spectrometer in reflected shock waves. The results are internally consistent, and the time constants τ are best represented by the following equation:

$$\mathrm{Log}_{10}(\tau[O_2]) = -14.29 + 17{,}000/4.58\,T$$

in units of sec moles/cm^3. Induction periods are about eight times longer. The following reaction mechanism is most consistent with the data:

(1) $H + O_2 = OH + O\ k_1 = 1/(4\tau_{\text{ionization}}\,[O_2])$
(2) $O + C_2H_2 = OH + C_2H\ k_2$
(3) $OH + C_2H_2 = H_2O + C_2H\ k_3$
(4) $C_2H + O_2 = 2CO + H\ k_4$
(5) $C_2H + O_2 = CO_2 + CH\ k_5$

Author

N65-17381# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

ENTRY HEAT TRANSFER AT SUPER-ORBITAL SPEEDS

James A. Fay Aug. 1964 33 p refs

(Contract Nonr-1841(93); Grant AF-AFOSR-353-63)

(Publ.-64-7; AD-606869)

Estimates are given of the expected relative magnitudes of modes of heat transfer at the stagnation point of a blunt body for flight velocities above 20 km/sec and for altitudes at which continuum flow exists in order that the principal mode of heat transfer may be determined. With respect to the convective heat transfer, the detailed theories applicable in the velocity range of 10 to 20 km/sec are reviewed and transport properties are discussed. Experimental measurements in shock tubes are compared with the theories. For higher velocities, an approximate theory is used to estimate the principal effects of ionization. Radiation heating due to continuum and line radiation is estimated from existing calculations to determine the flight conditions for which the shock layer becomes opaque and body size for which radiation exceeds the convective heating. It is found that only for bodies of large size at high altitudes will the radiant energy loss be dominant.

Author

N65-17395# Michigan Univ., Ann Arbor. Dept. of Aeronautical and Astronautical Engineering

THE FEASIBILITY OF A ROTATING DETONATION WAVE ROCKET MOTOR Final Report, 1 Jun. 1962– 31 Jan. 1964

J. A. Nicholls and R. E. Cullen Edwards AFB, Calif., AF Flight Test Center, Apr. 1964 220 p refs

(Contract AF 04(611)-8503)

(RPL-TDR-64-113; AD-449435)

A feasibility study is reported on the use of the detonative mode of combustion in a rocket motor rather than the deflagrative mode used in conventional, chemical rocket motors. The configuration adopted consists of an annular combustion chamber in which detonation waves completely fill the chamber cross section and propagate steadily in the same circumferential direction. This effect leads to the descriptive term, "Rotating Detonation Wave Engine" (RDWE). It is concluded that the droplet shattering process is of extreme importance in stabilized two-phase detonations. Experimental detonation velocities with gaseous mixtures at elevated initial pressures (15 atmospheres) and at initial temperatures down to the vapor saturation line of oxygen (about 112° K) are somewhat higher than those predicted theoretically. Theoretical heat transfer to the wall of the RDWE is of the same order as in the throat of a conventional small rocket motor operating on H_2 and O_2.

D.E.W.

N65-17443# Warner and Swasey Co., Flushing, N. Y. Control Instrument Div.

AN ATLAS OF INFRARED SPECTRA OF FLAMES, PART FOUR. ADDITIONAL NITROGENOUS LIQUID FUELS AND OXIDIZERS

Gunter J. Penzias Oct. 1964 62 p refs

(Contract Nonr-3657(00); ARPA Order 237-62; Proj. Defender)

(TR-31; AD-452631)

Quantitative infrared emission and absorption spectra in the 1μ to 15μ spectral region are presented for the following fuel-oxidizer combinations: Monomethylhydrazine (MMH) with oxygen, unsymmetrical dimethylhydrazine (UDMH) with oxygen, a mixture of 50% hydrazine and 50% UDMH with nitrogen tetroxide, MMH with nitrogen tetroxide, a mixture of 50% hydrazine and 50% UDMH with red fuming nitric acid (RFNA), and MMH with RFNA. The spectra were converted to digital form and recorded on punched paper tape. The data were processed by electronic computers and the results plotted by automatic data plotters. Comparison of the spectral data for different fuels with a given oxidizer indicated that the best combustion was obtained with MMH. Relative combustion efficiency plays a part in determining the spectral characteristics of the radiation. At low combustion efficiency, a continuum appears in the infrared flame spectra due to formation of carbon. The major features of the spectra are the 1.4μ, 1.9μ, 2.7μ, and 6μ water vapor bands; 2.8μ, 4.3μ, and 15μ CO_2 bands, and the 4.7μ CO band. The strong contributions of these vibration–rotation bands in the infrared overshadow the continuum radiation present in cases where combustion is not complete. The composition of each flame was calculated by standard equilibrium equations, using average temperatures determined from the measured emission–absorption ratios.

Author

N65-17449# Little (Arthur D.) Inc., Cambridge, Mass.

STUDY OF HIGH TEMPERATURE THERMODYNAMICS OF LIGHT METAL COMPOUNDS Progress Report no. 11, 1 Jul.–30 Sep. 1964

Alfred Büchler 30 Sep. 1964 5 p refs

(Contract DA-19-020-ORD-5584; ARPA Order 40-62)

(C-64362; AD-452623)

The nature of the mixed species in the lithium fluoride–zirconium fluoride system is being studied using a twin-crucible technique. The mass spectra of a LiF-ZrF_4 mixture and of pure LiF were compared. The LiF^+ and Li_2F^+ intensities for the solution correspond to a lithium fluoride activity in the melt of $a_{LiF} = 0.77$. The Li^+ ion intensity over the solution shows large contribution of a mixed species. The derivation of the formula of the mixed species is being sought by examining the variation of excess Li^+ (mixed species) ion intensity as a function of zirconium fluoride activity. The mass spectrum of lithium nitrate was examined at temperatures between 550° and 680° K. The principal metal-containing species are $Li_2NO_2^+$, $LiNO_2^+$, and Li^+ in the proportion 1: 0.06 :5.5. It is obvious that, as in the case of sodium nitrite, the dimer $Li(NO_2)_2$ is the principal gaseous nitrite species. The mass spectra of both sodium and lithium nitrite could be explained if dimer were the only stable species, since no significant variation of the $M_2NO_2^+ - MNO_2^+$ ratio with temperature was observed over temperature ranges of 100°. An unsuccessful attempt was made to design a high-temperature twin-crucible system which would permit direct measurements of the boron oxide activity over $BeO-B_2O_3$ mixtures.

R.L.K.

N65-17463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF PRESSURE ON RATE OF BURNING (DECOMPOSITION WITH FLAME) OF LIQUID HYDRAZINE

Albert C. Antoine Washington: NASA, Mar. 1965 11 p refs

(NASA-TN-D-2694) OTS: HC $2.00/MF $0.50

Measurements of flame properties were made for liquid hydrazine burning (decomposing with flame) in narrow glass tubes (5.6-, 9.5-, and 12.7-mm diam.; 10 by 10 mm square). They included temperature and light emission from the flame; color photographs were taken. The observations were all made between 1 and 18 atmospheres under a nitrogen atmosphere. The results support the postulate that the rate of propagation of the burning process is controlled primarily by a second-order gas-phase reaction rate, and that the observed variation from linearity in the burning rate–pressure curve is due mainly to physical factors rather than to a change in the course of the overall reaction. Relations are seen between the size and shape of the flame and the burning rates. The reasons

for the abrupt breaks in the burning rate–pressure curves are not clear, but the pressure variation is similar to those of extinction and quenching. Author

N65-17475# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
RESEARCH ON RHEOLOGIC AND THERMODYNAMIC PROPERTIES OF SOLID AND SLUSH HYDROGEN Quarterly Report, 16 Sep.–15 Dec. 1964
Robert F. Dwyer and Gerhard A. Cook 1 Feb. 1965 59 p refs (Contract AF 33(657)-11098)
(QR-6; AD-456657)

Experimental work on the determination of the molar volume of solid parahydrogen was completed. The experimental values along the melting line were found to agree with those calculated from previously determined heat-of-fusion data within about ±0.1%. Molar volume data were correlated in the form of a PVT diagram which shows isobars ranging from 0 to 400 atm pressure on a V-T plot in which the temperature range is 2° to 24° K. The shape of these isobars shows that solid hydrogen exhibits an interesting anomaly at temperatures near those of the melting line and at pressures above 150 atm. Solid hydrogen at conditions near those of the melting line is sufficiently fluid so that the true (equilibrium) molar volume can be closely approximated by applying the correct pressure at a given temperature and waiting about an hour. At pressures greater than about 150 atm more than the melting line pressure, solid hydrogen becomes rather liquid; it then flows at appreciable rates only when considerably greater than equilibrium pressures are applied. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-16658*# National Aeronautics and Space Administration, Washington, D. C.
[CONTRIBUTIONS OF RICE UNIVERSITY TO THE NASA PROGRAM IN BASIC RESEARCH: GROUND-BREAKING CEREMONY FOR SPACE SCIENCE AND TECHNOLOGY BUILDING]
James E. Webb 12 Feb. 1965 20 p Address presented at Rice Univ., Houston, Tex. Available from the Scientific and Technical Information Division

The extent to which Rice University and NASA have cooperated in the national space effort is reviewed, with particular emphasis on the materials research program in such areas as superconducting magnets, lasers, ceramics, and metal–gas interactions. The approval by NASA of the Owl satellite project to be conducted at the university is attributed to the four successful rocketborne experiments that were carried out by the university's scientists. The space program as a whole and, specifically, the investigation of space through scientific satellites are discussed. Attention is centered on the government–industry–university cooperation that makes the technological achievements of space exploration possible. D.S.G.

N65-16719# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 145
9 Feb. 1965 79 p refs Transl. into ENGLISH of selected articles
(JPRS-28677; TT-65-30296) OTS: $3.00

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N65-16845# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HERALD OF LENINGRAD UNIVERSITY: PHYSICS AND CHEMISTRY SERIES

29 Sep. 1964 219 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., no. 10, Ser. Fiz. i Khim., no. 2 (Leningrad), 1963 p 1–147
(FTD-MT-64-65; AD-608080)

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1. ON THE HARTREE-FOCK EQUATIONS FOR NONMETALLIC CRYSTALS M. I. Petrashen', N. N. Kristofel', and I. V. Abarenkov p 1–15 refs (See N65-16846 07-26)

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4. THE STRUCTURE OF BAND EDGE ABSORPTION IN CUPRIT A. S. Kondrat'yev and P. P. Pavinskiy p 31–44 refs (See N65-16849 07-26)

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7. APPLICATION OF ULTRASOUND FOR INVESTIGATION OF DYE-STUFF CRYSTALLIZATION PROCESSES K. N. Marenina and I. G. Mikhaylov p 65–85 refs (See N65-16852 07-23)

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11. AN INVESTIGATION OF THE CHEMICAL POTENTIALS AND ACTIVITY COEFFICIENTS OF THE COMPONENTS OF BINARY SOLID SOLUTIONS A. V. Storonkin, M. M. Shul'ts, and V. V. Korchagin p 120–127 refs (See N65-16856 07-06)

12. DISSOCIATION CONSTANT OF METHYL ORANGE V. V. Pal'chevskiy, M. S. Zakhar'yevskiy, and T. M. Kal'varskaya p 128–135 refs (See N65-16857 07-06)

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14. THE KINETICS OF DISSOLVING $AsSe_{1.5}$ Ge_x, $AsS_{1.5}$ Ge_x, $AsS_{2.5}$ Ge_x GLASSES IN SOLUTIONS OF CAUSTIC SODA V. N. Timofeyeva, G. M. Orlova, G. I. Ternovaya, and G. P. Tsayun p 148–157 refs (See N65-16859 07-06)

15. PHOTOMETRIC DETERMINATION OF SMALL CONTENTS OF IRON IN THE ULTRAVIOLET REGION OF THE SPECTRUM K. P. Stolyarov and R. Gerbach p 158–166 refs (See N65-16860 07-06)

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17. ON LEVELS OF NUCLEAR EXCITATION OF Si^{31} M. I. Guseva, K. I. Zherebtsova, V. F. Litvin, and Yu. A. Nemilov p 179–180 refs

18. METHOD OF CALCULATION OF TRANSIENT RESPONSE IN THE LADDER-TYPE LOW-PASS FILTER WITH LOSS B. V. Elizarov p 181–185 refs

19. KINETICS OF DISSOLUTION OF ARSENIDE-SELENIDE GLASSES WITH MINUTE ADDITION OF GALLIUM IN ALKALI SOLUTIONS G. M. Orlova and G. P. Tsayun p 186–194 refs

20. KINETICS OF DISSOLUTION OF THE GLASSY SYSTEM As–S–Tl IN ALKALI SOLUTIONS T. P. Markova and O. V. Il'inskaya p 195–204 refs

21. CONCERNING THE STABILIZATION OF POLYACETALDEHYDE N. G. Kasatkina and V. P. Kirpichev p 205–212 refs

N65-16907# RAND Corp., Santa Monica, Calif.
THE CHANGING RELATIONSHIP BETWEEN THE AIR FORCE AND THE AEROSPACE INDUSTRY
Robert E. Bickner Jul. 1964 86 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4101-PR; AD-608579)

A reexamination of the relationship between Government and the airspace industry is attempted, in order to clarify the efficiency and effectiveness of this relationship, and to bring into clearer focus the dilemmas and fundamental choices that face the Government in its dealings with the industry. The underlying assumption is that the competition between capitalism and communism will be decided by their comparative effectiveness in organizing progress. This memorandum is concerned with the procurement of major systems, the broad policy alternatives affecting the Government–industry partnership, and the Air Force problems that may or may not be the same as for other Government agencies. A proposed program for improving the relationship is presented. G.G.

N65-16989*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center
AEROSPACE RESEARCH APPLICATIONS CENTER SUMMARY REPORT, 1 APRIL TO 30 JUNE 1963
Arthur M. Weimer 10 Jan. 1963 58 p Includes Proc. of Conf. on Ind. Appl. of Aerospace Res.
(Contract NASr-162)
(NASA-CR-51214) OTS: HC $3.00/MF $0.50

A report of the center's activity for the period is presented, and includes speeches from the Conference on Industrial Applications of Aerospace Research. Speeches presented at the conference covered (1) the scope of the work at the Aerospace Research Applications Center; (2) the relation between the university, industry, and NASA in research; (3) industrial utilization of NASA-generated technology; (4) data processing for industrial application; (5) plans for a new center; and (6) the relation between aerospace research and economic development. A list of the participants in the panel discussion is given. J.L.C.

N65-16990*# Indiana Univ. Foundation, Bloomington. Aerospace Research Application Center
ARAC SERVICES TO MEMBER COMPANIES ARAC Operating Manual
Arthur M. Weimer Oct. 1963 45 p 3d ed.
(Contract NASr-162)
(NASA-CR-52472) OTS: HC $2.00/MF $0.50

The ARAC Operating Manual describes the following services: (1) library—retrospective search service, (2) library selective dissemination service, (3) industrial applications (NASA

flash sheet) service, (4) engineering information service on current problems, (5) science programs, (6) management programs, and (7) experimental programs. I.V.L.

N65-16991*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center
ARAC SERVICES TO MEMBER COMPANIES Second Quarter Operating Manual, Jul.–Sep. 1963
[1963] 37 p
(Contract NASr-162)
(NASA-CR-51721) OTS: HC $2.00/MF $0.50

Aerospace Research Applications Center's services are discussed as they relate to the progression of member company tasks from the identification of new markets and market segments, through advanced product planning, research and development planning, execution of research and development projects, product and process development, final engineering, and marketing. I.v.L.

N65-16994# Joint Publications Research Service, Washington, D. C.
CERTAIN METHODOLOGICAL PROBLEMS OF MODELING
V. A. Venikov 18 Feb. 1965 19 p Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 11, 1964 p 73–84
(JPRS-28829; TT-65-30361) OTS: $1.00

The problems of modeling are briefly considered, and the history of modeling is presented. The importance of modeling in the present world of computers and nuclear physics is emphasized. Problems that can be solved with the aid of modeling are divided into three groups: (1) those directed towards the development of a theory, verification of hypotheses, or the collection of facts; (2) those facilitating the solution of practical problems, making it possible to obtain operational experience in shorter time; and (3) those improving the process of instruction and, in particular, assisting in the mastery and practical application of various theories. Modeling is also categorized as being either mental or material, and is disucssed by type under these two headings. D.E.W.

N65-17181# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NAVAL AIR DEFENSE OF SHIPS
K. W. Morosow 20 Oct. 1964 107 p Transl. into ENGLISH of the book "Luftabwehr der Schiffe" Berlin, Deut. Militarverlag, 1963 p 1–119
(FTD-TT-64-585/1+2+3+4; AD-607585)

Air operations against naval targets, and antiaircraft capabilities of modern warships including weapons, ammunition, and fire-control equipment are discussed. Aerial combat experiences, and the organization for air defense aboard combat ships under conditions of modern warfare are presented. It is concluded that only precise organization and faultless cooperation among all personnel can ensure the successful use of air defense capabilities. E.E.B.

N65-17301# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 148
17 Feb. 1965 111 p refs Transl. into ENGLISH of selected articles
(JPRS-28796; TT-65-30350) OTS: $4.00

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3. HIGH-SPEED ANALYSIS AND ITS FUTURE Tsung-hsiang Chou and Tsung-hsiang Wang p 28–40 refs
4. THE DEVELOPMENT OF METAL DIE CASTING IN CHINA Ts'ai-fei Sung p 41–53
5. SOME PROBLEMS OF HIGH TEMPERATURE THERMAL CRACKING OF PETROLEUM Wen-chüan Yu p 54–66 refs
6. CARBAMATE INSECTICIDES AND THEIR SYNERGISTS Chin-liang Chin p 67–73 refs
7. MINIATURE ROCKETS Shih-hsien Lu and Hsien-chen Hsu p 74–79
8. OBSERVING THE LAUNCHING OF A MINIATURE ROCKET p 80–82
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N65-17370*# National Aeronautics and Space Administration, Washington, D. C.
THE NATIONAL SPACE PROGRAM: HIGHLIGHTS OF THE PAST YEAR AND PROJECTS FOR THE FUTURE
James. E. Webb 23 Feb. 1965 18 p Address presented to the Joint Tech. Soc., Poughkeepsie, N. Y., 23 Feb. 1965 Available from the Scientific and Technical Information Division

Mr. James E. Webb from the National Aeronautics and Space Administration, presents NASA's plans and programs over a broad spectrum. Highlights from last year's achievements are pointed out with emphasis on the meteorological satellite program and the communications satellite program. Some areas of future research are outlined and NASA's participation and sponsorship in space-related research and development is discussed. G.G.

N65-17399*# National Aeronautics and Space Administration, Washington, D. C.
THE CHALLENGE OF THE SPACE AGE
James E. Webb 23 Feb. 1965 18 p Address presented at the U. S. Mil. Acad., N. Y. 23 Feb. 1965 Available from the Scientific and Technical Information Division

Mr. James E. Webb from the National Aeronautics and Space Administration, emphasizes the importance of space science and technology for our society. The essential elements of the space age have their roots in our national life and character, are significant to our security, create power, stimulate the tools and vital processes for progress in the Great Society, and form the critical dimensions of its challenge. The future of man in space cannot yet be distinguished from his possible military value there. The development of extensive and growing space capabilities in both the United States and the Soviet Union points to the international aspect of the space age. Our power to survive as a great and vigorous society is in process of being proven again through our space efforts. G.G.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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